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October 1955

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To explore, enjoy, and preserve the Sierra Nevada and other scenic resources of the United States and its forests, waters, wildlife, and wilderness; to undertake and to publish scientific, literary, and educational studies concerning them; to educate the people with regard to the national and state forests, parks, monuments, and other natural resources of especial scenic beauty and to enlist public interest and coöperation in protecting them.

JOHN MUIR, President 1892 to 1914

Sierra Club Bulletin

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Sierra Club Bulletin

The California Himalayan Expedition to Makalu

Part I: The Approach

By RICHARD C. HOUSTON

As the nine of us clambered on the huge Navy Super Constellation at Travis Air Force Base, none of us quite knew what was in store for us, but certainly here was the realization of a mountaineering life. We were on our way to the Himalaya! The long, difficult, sometimes desperate struggle to obtain permission and to finance and outfit the expedition was now over, and the time of entering an unknown area and setting climbing boots on one of the great 8,000-meter peaks was fast approaching for the California Himalayan Expedition.

The California Himalayan Committee, which had laid the groundwork for the expedition, first saw light in Oakland, California, in 1951 at the instigation of Fritz Lippmann and Alfred Baxter, Jr. The alluring maps of Asia were unrolled and dirtied with use and ultimately the noble peak of Dhaulagiri (26,795 feet) in central Nepal was selected by the committee. The machinery started, and the first of many letters took the slow mail route to Katmandu, capital of Nepal. After five long months of waiting, the message arrived—"permission refused"! It was only many months later that we learned a Swiss expedition had already been given permission for that peak; this had been the reason for refusing permission to us. At a low ebb, the committee resubmitted its request, this time for Makalu (27,790 feet), a giant neighbor of Everest on the Nepal-Tibet border. Makalu—unclimbed, never attempted, unknown. We would be the first. And finally in the late summer of 1953 came the gratifying word from Nepal; in 1954 we could go to Makalu.

Now came the preparations. Actually these were well under way. Food

and equipment had been tested on Mount McKinley and Mount Robson in 1953. Many interested companies had been asked for aid and advice. The Sierra Club membership was approached to help finance the venture, an advisory committee was established, and official endorsement was granted by the Sierra Club and the American Alpine Club.

With the mountaineering program well in hand, the scientific work received serious consideration. Under the direction of Nello Pace of the University of California, a vital project of physiological research on high-altitude stress was worked out, while Larry Swan gathered the necessary equipment for the biological collections, ecological studies, and mapping. Because of the expected importance of the physiological studies, we received grants from the National Science Foundation and the U.S. Air Force. When all preliminary preparations were complete, the advisory committee selected Will Siri as leader and Nello Pace as deputy leader. Larry Swan (biologist), Bruce Meyer (physician), and mountaineers Bill Dunmire, Dick Houston, Fritz Lippmann, Bill Long, Allen Steck, and Willi Unsoeld completed the group. Each had climbed in many ranges, but we stressed compatibility as the final guide for selection since it is such a vital factor in high climbing.

The planning itself would fill a book. Far into many nights we had been discussing tents, parkas, special food packaging, ply veneer porter boxes, down clothing, ladders for crevasses, Sherpa clothing and equipment, and all the innumerable other items that are needed for an expedition of this kind. The planning seemed successful, and the group felt confident at Travis on that February 18, 1954.

The members were split for the trip, with Willi Unsoeld flying east two weeks after the others had gone westward. The main group touched down at Hawaii, Wake Island, Tokyo, Manila, Saigon, Bangkok, and finally reached the teeming city of Calcutta. During the stop at Tokyo the Japanese Alpine Club feted the members of the expedition. Japanese members of the expedition to Manaslu (26,658 feet) of that year and our Makalu group exchanged views on mountaineering.

In Calcutta we were introduced to the slow pace of the East and the remarkable workings of a young government that was operating from the book and was completely stumped because there were no regulations to cover Himalayan expeditions. Will Siri's patience was tested time and time again as cumbersome Indian customs rules blocked the way for moving onward to Nepal. Time became more critical since we had 250 porters and 13 Sherpas already on our limited payroll at Dharan in Nepal. With the situation becoming desperate, Pace flew to New Delhi and requested

Ambassador Allen to intercede for us with the Indian government. This he did, and on March 6 Nello flashed the welcome news—we were finally cleared. With a mass of paper work that would do credit to any governmental agency, Siri pushed through the necessary forms and the expedition could finally move by train to Nepal on March 11.

To hold the porters, Swan, Unsoeld, and Long had proceeded to Dharan and had consulted with Ang Tharkay, our native chief and transport officer. With dubious assurance Ang Tharkey convinced the waiting porters that the Sahibs would arrive shortly and that they should sit tight. This was not too bad for them since they were receiving half pay (two rupees) just for remaining in Dharan at the end of the truck road in Nepal.

The train trip from Calcutta to Jogbani on the India side of the India-Nepal border involved the usual Indian discomforts as well as some humor. And of course the problem of transporting 8,000 dollars in porter wages gave us all some concern. Once on the first-class car with the windows locked and the door bolted we felt safe. Bill Dunmire proceeded to look over his own coin collection, to be used for tips and small purchases in Nepal. Lo and behold, the famed Calcutta New Market had realized another victim, for the usual ratio of half counterfeit became all too apparent.

When the train reached the Ganges River, we had to unload our 60-pound porter boxes and the other gear, so that human heads could transfer the five tons to the special river steamer that carried it across to the north bank where another train was waiting to continue the journey to Jogbani; there was no bridge. We had breakfast on the steamer, and discovered with dismay that the Indians had learned the art of coffee making from the British.

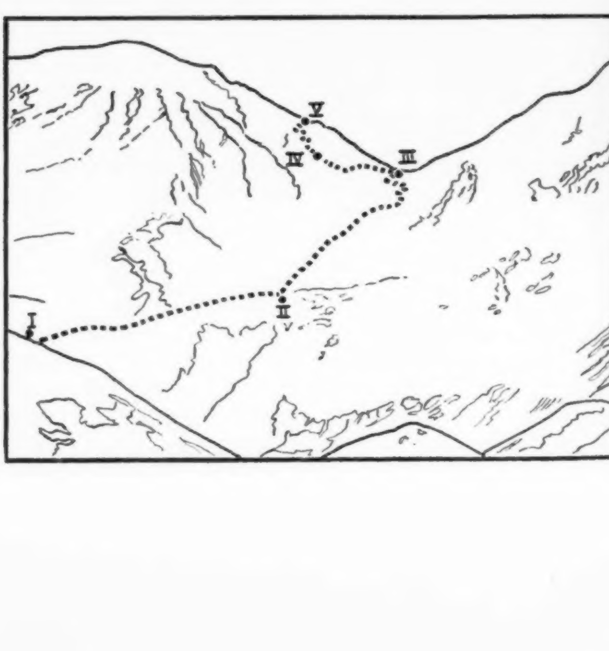
On the north bank of the Ganges the tedious task of transferring our boxes from the steamer to the waiting train had to be carried out. It was not the last time: Seventeen miles and five hours later we had to change trains to get to the main line to Jogbani—which meant yet another reloading operation.

At the Nepal border the rail trip ended; here we met an advance group of the Sherpas. They had apparently met every train for a week. Also there were Willi Unsoeld, Bill Long, and Larry Swan.

The unloading to trucks could wait, for we were hungry and wanted to sample our new cook's first attempt to feed Americans. This also was Nello's signal, and blood and urine were tested. After once again clearing customs, the expedition moved the remaining 30 miles over one of the three main roads in Nepal and arrived in Dharan at dusk, there to meet

Ang Tharkay. In lantern light he worked long into the night assigning loads to the crowding natives who were hired to help move us the 150 miles to Base Camp in the Barun Valley at the foot of Makalu. With the last load detailed the group settled down for a final sleep before the great day arrived. Bright and early it dawned, and we learned the custom of being greeted and awakened with a hot cup of tea. Not take it? Well, you didn't do such things, since the grinning face of Psang Dorge just stayed there until you did.

The route to Makalu was mostly over traveled "roads" but no one evidently had ever made the entire trip at one time. So we depended on local knowledge and Ang Tharkay for short cuts and camping sites. We traveled with 250 male and female porters—150 of whom had come from the Sola Khumbu region in Nepal, the home of the Sherpas; the rest were hired locally. Each day the porters would leave before eating and stop at about nine in the morning for food, during which time we would overtake them. We would then lose the lead again at "Sahibs' lunch," with a dead heat often resulting at the camp spot at about four in the afternoon. The porters proved to be effective load carriers, but getting the right boxes into camp early enough was always a struggle as each Sherpa considered his load his personal responsibility and refused to part with it unless ordered to do so by proper authority. Even this method did not always cover all porters, and important food boxes were sometimes tracked down on the Nepalese hillside to recover the evening's rations.



MAKALU FROM BASE CAMP

Makalu Reconnaissance, 1954

The first ascent of a great peak was to be another party's trophy, but this was the first California Himalayan Expedition, and theirs was the first reconnaissance of Makalu (27,790).

PHOTOGRAPHS BY WILLIAM SIRI AND ALLEN STECK

TRAVERSIN

TRAVERSING THE BARUN GORGE, WHERE AVALANCHE SNOW PILES 150 FEET DEEP

CROSSING THE WATERS OF THE BARUN KHOLA ON DECAYING TIMBERS

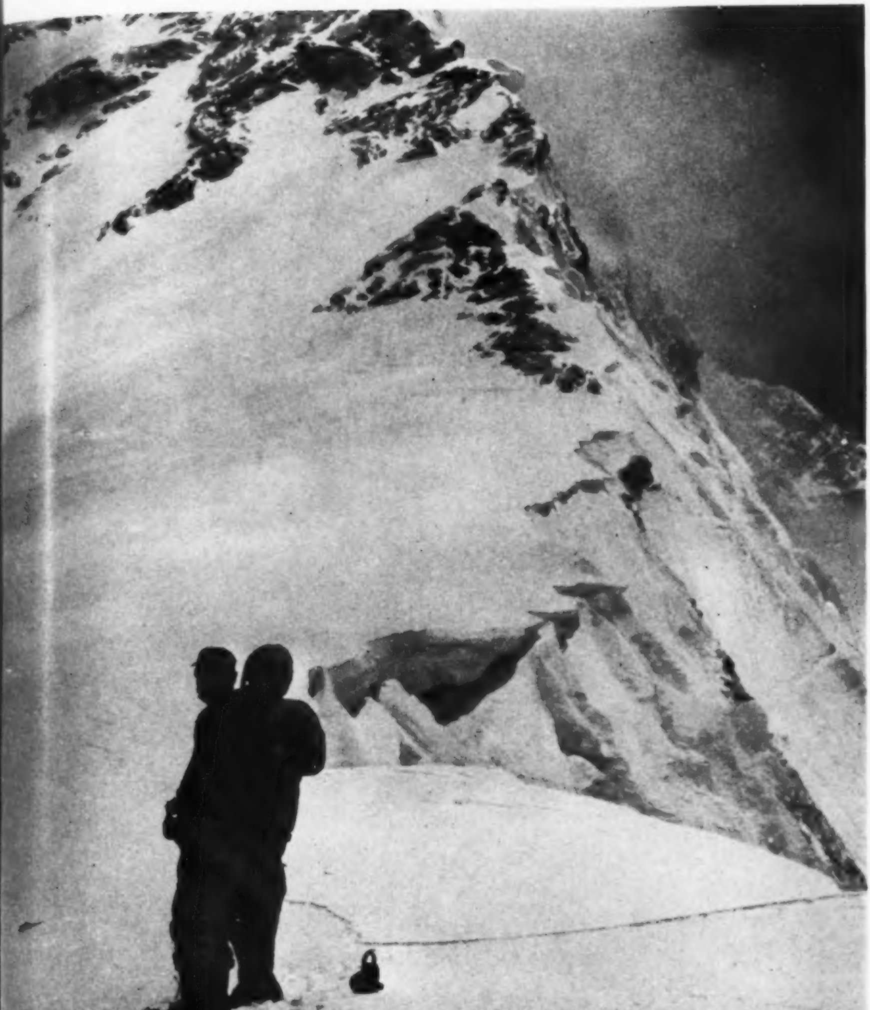
ANG THAR

ANG THARKAY, SIRDAR OF THE SHERPAS, AT BASE CAMP

MAKALU FROM
BASE CAMP (15,500)

FRESH SNOWFALL AT CAMP II. PEAK 6 (UNCLIMBED) IN BACKGROUND

CREVASSE ON APPROACH TO CAMP III



HOUSTON AND DUNMIRE ON THE COL JUST ABOVE CAMP III; IN BACKGROUND, FOUR CLIMBERS ASCENDING TO CAMP IV

ING OUT C

ING OUT CAMP II AFTER A STORM

MOUNTAINEERS AT BASE CAMP, REST DAY. (*Back row*) [illegible]

The trek to Makalu involved going over four great ridges, one of which rose to 12,000 feet, and dropping into three river gorges en route: the Tamur (flowing into the Arun from the east), the twisting Arun itself (twice), and the Barun (flowing into the Arun from the north).

At Dhankuta, between the first two river valleys, the local governor, called Bara Haken, offered his official welcome for his territory and issued us a permit to climb on Makalu, which is in his district. At Khanbari, on the bank of the Arun River but high above it, several porters left us, but local men were able replacements. So far, the idea of bringing 150 porters from Sola Khumbu had worked well; most of these loyal people remained with us for the full trip to the mountain.

We traversed the third ridge and descended the second time to the Arun River at Num, a few miles south of the point where the Barun flows into the Arun. A rest day prepared us for the rugged route ahead where we would leave the regular trade routes. The Num bridge we will always remember. This bamboo structure, stretched over the turbulent Arun, seemed to have more motions than physics could describe. The day of crossing was a day for photography as the sun, river, and bridge co-operated.

The tenth day out we moved into Yetung, a village apparently never before visited by Westerners. At lunch we had about 200 visitors as the local city folk gathered around for a look-see at the strange goings on. Beyond Yetung the trail disappeared into the dense Nepalese underbrush and we followed routes of sheepherders used for centuries to get to the high summer grasslands. Ang Tharkay, ever pushing, moved the group upward to the high ridge north of the Arun River and parallel to the Barun River. The expedition moved along the crest hoping to reach a point where we could drop into the Barun Valley above the gorge (impassable according to local information). This proved to be no mean job, because the weather became stormy and the low visibility kept the group groping around the ridge looking for the key to the descent into the valley.

Here, at 12,000 feet, with the Sahibs and Sherpas as guides, the long string of load carriers trekked slowly forward onto snow-covered slopes. We realized that we were going to lose another 50 porters, because the bare feet of the Nepali are hardy but not capable of withstanding more than a day on ice and snow. To our relief, the Sola Khumbu men and women never faltered. From matérial left by those who quit, our first cache was established, to be picked up several days later and brought to Base Camp in time for the climbing on Makalu.

We now had to decide whether our route down a steep little canyon

really led to the Barun Valley. Here the expedition faltered for two days. The natives cut pine boughs and with only tarps for shelter lived successfully through a blizzard with undampened spirits, while for the Sahibs the special altitude tents were brought out for the first time. Our situation provided a working test for the special VHF and UHF radios, as reconnaissance teams moved up the ridge and also down into the unknown canyon. The difficulties of transmitting around corners became evident in these line-of-sight radios. Those in camp learned to wait—an art in which all were to become very proficient in the future.

Eventually, a welcome yodel announced the return of the scouts from the depths of the canyon. Yes, it was the Barun. A rough stretch was ahead, but the scouts said we could make it. That was all we needed.

The 150 remaining porters coasted downhill over snow and descended into the main gorge (we hoped) of the Barun. The gods must have been smiling, for the remains of the winter avalanches now provided a highway of sorts over the waterfalls, and past sheer walls and steep cliffs. By noon the rugged section of the canyon stopped the lead porters, who gazed upward at a fantastic Himalayan gorge, impassable except for fish going downstream. Planning for this, Steck, Long, and Unsoeld had moved ahead and were establishing a series of fixed ropes, bridges, and steps leading directly up from the depths of the valley and traversing the steep cliffs about 500 feet above the canyon floor. With impatience not expected in the East, the coolies decided to move on—little fazed with the ropes, slippery footholds, and wooden bridges. At the end of the traverse, high above the canyon bottom, our cook, Thandu, moved into the position of chief engineer. Building principally with bamboo, he produced a 10-foot walkway over space and then calmly directed the first porters across with great pride. Once the route was established, the remaining part of the day was used in ferrying the 150 men over the tricky traverse. By six in the evening it became apparent that the entire group would not reach the camp on the river, but it mattered little because the coolies mounted trees to sleep or set up camp sites where they were, and cooked and slept practically hanging on the cliff. The only casualty proved to be a box of mush and a porter's pride. The climbers had given their all, and dropped into camp very wet and tired. They slept with a realization that the way now appeared certain. Bill Dunmire spent the night alone at the start of the traverse, without dinner or companions.

During the next five days we moved up the Barun, which was now widening out. Bridges and trails used by sheepherders allowed smooth traveling. But no sight of Makalu. Nepal appeared to be suffering from

its own variety of smog as visibility turned from bad to worse. At 14,000 feet we set up camp, another milestone. We arrived in a cold wind and snow storm, a usual afternoon condition by now. It proved too much for 50 more of our coolies, however, who decided to give up and return. Ang Tharkay was forced to regroup, while the Sahibs mulled over equipment and food to decide which to take and which to cache. Here we left the second of three caches on the approach.

Another sight greeted us as the morning clearing revealed the top of the canyon for the first time. There were 20,000-foot peaks—the "foothills"—unnamed, unclimbed, and probably unthought of until now. Our camp was near timber line and open slopes proved cold and windy, but the welcome wind was finally clearing the skies. We were all now eager to press on for that glimpse of the big one. Another camp at 15,000 feet, another cache, snow, and then the Sahibs dumped packs and headed for that last hill, which proved to be some hike. Thus, on April 4, the final hill was turned in the winding canyon, and for the first time the bulk of Makalu stood before us; the huge southwest face filled the entire horizon.

Base Camp was established at 15,500 feet on a small grassy ledge about two miles from the base of the mountain. From there we looked directly up to the tantalizing southeast ridge. Now our coolies had finished their work. With their pay in their strange frocks, they bade us farewell. With rugged determination they decided to continue on up the Barun toward the north and Mount Everest, which was twenty miles away. Eventually these natives climbed over a 20,000-foot pass for the reported short cut to their home land. The love of adventure was ever apparent in Nepal. Here were ill-equipped men and women moving into unknown territory high above timber without any shelter, crossing great glacier systems with relaxed daring, and succeeding. We felt rather humble with our special sleeping bags, tents, down clothing, and Primus stoves.

Base Camp provided a moment of relaxation as the team moved into quarters that would not be vacated until June. Sorting, assembling altitude units, making rope ladders, issuing gear, and planning took up every minute of our time.

Since Makalu was a virgin peak, the problem of route had until this time been studied on the only available photos. But now we had the great peak right on our door step, and the time for reconnaissance had come. Two teams were selected by Siri. Unsoeld, Dunmire, Lippmann, and Meyer trekked to the southeast of the peak to look over the southeast and east ridges of the mountain. The rest of us went up the Barun Glacier, which ended just above Base Camp, and turned up the plateau glacier to

the northwest of Makalu for a look at the important northwest ridge, which had been considered in early planning.

One day out of Base Camp to the north brought us the first view of Everest, a mere 20 miles to the north. From the Barun Glacier the huge snowy plume of the North Peak recalled the many struggles on this highest summit. Everest was indeed impressive and the unbelievable south face of Lhotse added to the dramatic scene. But we had other problems.

Three days out of Base Camp on the Makalu Glacier, northwest of the peak, we put our highest reconnaissance camp at 19,000 feet. In bright morning weather we climbed on the broad glacier for views of the northwest ridge and the great step on the ridge at 26,000 feet. This step looked like a sheer, Yosemite-type climb about 1,000 feet high; but what about turning the ridge to the east? The western side was impassable and several photos taken in 1921 showed the opposite side a tough go. We came to the conclusion that the southeast ridge must be better. It was on the way to the northwest ridge that Ed Hillary was to become sick two months later at 20,000 feet and to be quickly moved out. Eight months later the French climbed to 25,000 feet on this ridge before giving up. It is still undecided whether the great step is passable.

One week later both reconnaissance groups returned to Base Camp with a few more red blood cells in their veins. Each group had a determined opinion that the route surveyed by the other group must be preferable. After two days of consideration and a realization that time was moving on, we decided upon an attempt on the southeast ridge, which rose uncompromisingly above Base Camp and would involve 2,000 feet of ice fall and 3,000 feet of steep ice and snow to the ridge at 21,500 feet. From there the route seemed unusually clear along a serrated ridge extending to the summit itself.

The choice had been made and the full weight of the expedition was now to be thrown at the peak. Nello Pace and Larry Swan were busy with their special studies. The Barun Valley became a base line for our theodolite as Swan collected angles from important points to be used later for improving the one map. Bill Dunmire's shotgun also popped away and his bird collection increased as he took specimens at elevations up to 16,000 feet. The remaining food units were packed. The Sherpas were trained in rope handling, belays, and rappeling, as the Barun Valley became Cragmont Rock for a day. Acclimatization progressed. We were about ready to start for the southeast ridge.

The weather seemed to follow a typical pattern. There was sun until ten or eleven in the morning and then a progressive influx of clouds bring-

ing snow all the way up to the higher levels of the mountain. High on Makalu the northwest monsoon was raging as 100 mph winds whipped the ridges unmercifully, indicating that we must be cautious and not arrive too high too soon. It was these very low clouds and the winds high on the peak that would eventually halt our attempt.

Part II: The Climbing

By WILLIAM LONG

After we had voted on the route to take, we prepared for the move toward the southeast ridge, which could be seen occasionally through clouds and storms. The ascent would involve reaching this ridge via the glacial system on its southwest flank and then following the ridge toward the summit. We estimated that before the summit attempt could be made about nine camps would be needed. The plan called for Camp III to be located on the col formed in the southeast ridge between Makalu and some small peaks to the southeast. This we named the South Col, whose elevation we estimated at 21,500 feet. Below the col were the extensive glaciers that covered the slopes with masses of steep ice, through which our route led. These glaciers terminated in very steep cliffs and tumbling ice falls at an elevation of about 16,000 feet.

Above the South Col rose the southeast ridge of Makalu—and what a ridge it was! Upon observing our proposed route, Sir Edmund Hillary commented: "In my opinion, this is one of the most difficult ridges ever attempted in the Himalaya." We knew we had a real task before us.The ridge had a general angle of about 40 degrees, while some sections were steeper. At 26,000 feet the ridge leveled out before again sweeping up toward the summit.

In theory all looked well, yet we knew we could not climb high unless the weather cleared during the "lull" period which supposedly precedes the southern monsoon by about three weeks. Our hopes for good weather ended when the monsoon arrived early and the lull failed to materialize. Such is luck in Himalayan climbing.

To get things under way, Al Steck and Willi Unsoeld ascended the cliffs that formed the first hurdle to the long steep ice slopes leading to the col. During these early days on the mountain, we planned to establish and completely stock the lower camps (Camps I, II, and III). Camp III would be particularly important as its position on the col was ideal for an advanced base. Climbing above Camp III this early in the season was out of the question for several reasons. The lower camps must be completely

stocked with food and equipment for 20 or more days. Also, the high winds on the ridge made any climbing there extremely dangerous, if not impossible. Another consideration was the necessity of acclimatization to these extreme altitudes.

Al and Willi proved excellent route finders. They discovered a steep talus chute that provided a gap through the first cliff barrier at 16,000 feet. After three hours of steady going they established Camp I beside a beautiful glacial tarn just below the huge glacier sweeping the southwest face of the mountain. No pleasanter place could have been found in this world of rock and ice. The tents were protected from the wind by rock outcrops. Many of us thought of taking a swim in the tarn but only Bruce Meyer managed to get completely wet.

After passing several nights at Camp I, Al and Willi became accustomed to the 16,500-foot elevation. During the day they probed for a route through the jumbled seracs of the lower glaciers. Their task was to find a location for Camp II. During this period of locating and stocking Camps I and II my own physical condition became so poor that I had to descend the Barun Valley to 13,000 feet and join Larry Swan. Larry was busy collecting plants and animals and I spent my time investigating the geology of the Yosemite-type Barun Valley. Aided by the increased oxygen supply my health rapidly returned, and with a rucksack full of rock specimens and notes I climbed back from Swan's camp to Base Camp, eager to join the climbers on the mountain.

On my first trip to the upper camps, the improvement in my physical condition was apparent. Dick Houston and I, accompanied by four Sherpas, started for Camp I. It was amazing to observe these men, each weighing a mere 130 pounds, carrying loads 25 per cent heavier than the 40-pound load that dragged on my back like an anchor. During a rest stop, Dick Houston, who had made the ascent between Base Camp and Camp I several times, pointed out a spot where Unsoeld had amazed the Sherpas with his rock-climbing skill. Nothing would do but for all of us to interrupt our ascent for a while and to duplicate Unsoeld's efforts on this large boulder. When the Sahibs had finished most of this extra climbing, we returned to the tedious grind up the steep talus chute to Camp I, regretting the energy lost while rock climbing at 16,000 feet. Soon we faced a steep, slightly touchy rock traverse and it became apparent for the first time that the Sherpas were depending on us for the technical skill of climbing. What they lacked in mountaineering skill, however, they compensated for by their unusual endurance and determination. Our relationship with the Sherpas was one of mutual admiration and respect.

We safely reached Camp I. Next morning our group of six set off to carry more loads to Camp II, following the line of bamboo "willow wands." The route changed from talus to glacier shortly above Camp I and then threaded through the very complicated system of seracs and crevasses, after six hours eventually reaching a flat area at 18,000 feet where Camp II was located. The view from Camp II held us speechless as sweeping glaciers joined the jagged silhouette of 21,000- to 25,000-foot peaks that surrounded us. Beautiful as the scenery was, we felt uncomfortable as the cold penetrated our clothing. Camp II was not a warm spot of luxury like Camp I. Here a disappearing sun meant down jackets and extra gloves. For the first time we deeply appreciated the excellent tents that Gerry had made for the expedition. The double-walled construction successfully kept out the cold and wind while the two fiber-glass wands held the sides away, giving welcome room to tired climbers.

The days that followed were spent with the irksome task of relaying food and equipment from camp to camp. Our Sherpa strength of ten was far below the ordinary standard for major Himalaya expeditions and meant many additional trips back and forth for each man.

As coördinator, Will Siri designed a chart which told each climber days in advance where he would be. The code on this chart often was baffling at first, but proved useful in scheduling our movements, and each of us attempted to keep up with the complicated letters and numbers.

Above Camp II crevasses and seracs became a lesser problem, but the slope steepened considerably and the remaining crevasses usually had great width and depth. For the first time our ladders became useful in bridging the larger ones. We had stepped across one crevasse on the first trip to Camp III. Later it was bridged with our ladder, but eventually we discovered a new route around it. When we passed this crevasse the last time it was more than 30 feet wide. The first move above Camp II was made by Will Siri and Al Steck with four Sherpas. They nearly reached the col and set up a cache a few hundred feet below the col's crest.

The next day, joined by four Sherpas, Al Steck, Willi Unsoeld, Bruce Meyer, and I pushed our weary way up the steep slopes, passing the spot where Will and Al had left the cache. At 21,000 feet our feet dragged heavily as we floundered up the last few feet to the site for Camp III. Since the entire area below the col sloped steeply, we dug ledges into the snow for the erection of two tents in which Bruce and Willi spent the first night at Camp III. Al and I returned to Camp II and repeated the journey again the next day. Thus Camp III—two small tents—was established. Through the weeks that followed this camp was to be the site from

which the long and dangerous efforts up the ridge started.

Until Camp III became much stronger, however, the entire group had to continue the monotonous job of relaying loads up the mountain. The haul proved particularly difficult between II and III, where the 35- to 50-degree slopes reduced the pace to a snail's gallop. But on one occasion Bruce, in a burst of tremendous enthusiasm, set the record of 4½ hours (2 hours below average) for the Camp II–Camp III trip. This rate of speed on his part was not again duplicated until the final day of the return march when he burned up the remaining miles to Dharan and "civilization" in a dead heat with Nello Pace.

Relaying through the masses of ice and snow lost its glamor now, as the monotony of the task increased. I remember Al's complaint, after his seventh trip from Camp I to Camp II, that he preferred a new "beat." Those of us working on the Camp II–Camp III run were certain that one of our trips equaled two of either of the lower hauls. Regardless of the complaints, the build-up continued and a formidable camp was established on the col. Eventually we were ready to go higher.

The schedule called for three distinct steps in our attempt to climb Makalu: (1) the establishment of Camps I, II, and III; (2) the enlarging, strengthening, and stocking of these camps plus reconnaissance, and the establishment of Camp IV; (3) the bitter struggle up the ridge above Camp IV. We were now halfway through the second step.

To discover a route and find a location for Camp IV, Bill Dunmire and I started off at six o'clock in the morning. Our goal was a spot 2,000 feet above Camp III, behind a point in the ridge called The Bump. We fought our way not on the ridge itself, but on the face below it, following a route later referred to as the "face route." Twelve hours later, Dunmire and I returned to Camp III, tired, cold, and beaten, having reached very steep rock at about 22,700 feet—far short of The Bump.

The next day Houston and Unsoeld followed our tracks along the face route and reached a point 300 feet farther, to set a high mark that was not surpassed until the final days of the fight for the ridge itself. But even their point was several hundred feet and many hours short of the originally proposed Camp IV site. We now realized that Camp IV would have to be placed closer to Camp III on the steep snow below the ridge. But the most gentle snow slope in the area where Camp IV must now be placed was at an angle of more than 45 degrees—an avalanche face! Two caches were placed at that point.

When Bruce and I with the two Sherpas Gombu and Mingma Tsering reached our two caches, it took several anxious moments to find them be-

cause they were completely buried by snow. But when we discovered them our problems had just begun, for as fast as a man could dig a hole, it would be filled by cascading snow. Diversion ditches helped slightly, and finally a diversion wall stopped all but large snow slides.

It was apparent that a tent would not stand more than a few minutes under such conditions—so we dug a cave. Rock stopped us from digging too deeply so the cave turned out to be long, narrow, and shallow.

It took until dark to get the hole finished. The four of us then prepared our dinners and ate. Bruce could only drink. After crawling into our bags we discovered that the outer two men would not be completely inside the cave. On their own insistence the two Sherpas had the unenviable position of being only partially protected by the cave.

At about midnight I felt my feet being covered with snow and realized that a snow slide had passed over us. Both Gombu and Mingma were covered completely. Bruce rushed to dig them out but forgot to cover his sleeping bag or don a parka. As a result, his bag filled with snow and he became so cold and damp that he could not sleep for the rest of the night.

Two more snow slides came down during the next hour. Following this, we managed to get Mingma, who was getting the most snow, into the cave with us. We were crowded, but those who were dry slept quite well, thanks to sleeping pills. Camp IV was as miserable and uncomfortable a camp as any climber has placed on a mountain.

Above Camp III, in addition to almost daily afternoon storms, we were plagued by high-altitude deterioration. The first symptom one felt, other than shortness of breath, would be a severe headache which was usually stopped by aspirin, or codeine, or both. Following this would come lack of appetite and inability to sleep. The latter was combated by a dosage of one of three types of sleeping pills. Though few of us ever learned the professional names of these pills, they were easily recognized and separated by their colors. Once, when reeling around Camp III in dizzy motions, I learned that mixing pink capsules with yellow ones was a wrong move. The big black ones were rejected by the Sherpas, who wanted the pleasant-colored pink ones.

With Camp IV "established," we returned to Camp III, focusing our attention on Camp V. The weather became worse as June approached, without the long-awaited lull. Each day a new coat of snow would fall after a few hours of moderately clear weather in the morning. Under these difficult climbing conditions the number of fit mountaineers at Camp III diminished rapidly.

Al Steck and I were to make the next attack for Camp V with Mingma

Tsering, Gombu, Kippa, and Ang Phutar. These were four of our best Sherpas. All of them, except Ang Phutar, carried their loads to the eventual high point at Camp V.

The deep new snow made our new track to Camp IV torturous. Al's fatigue held him back more and more. I shall not forget my friend struggling up the last steep snow face to Camp IV with signs of severe strain in his face, as he fought through waist-deep snow to arrive at the cave called Camp IV. Many of lesser determination would have given up and turned back.

Next morning, having gained a measure of strength from fitful sleep, Al emerged ready for the search for a route to Camp V. Our choice was a spur descending from the main ridge. This turned out to be a mistake, because the route proved to be much too difficult for laden Sherpas.

Conditions remained far from ideal. Having gingerly crossed several hundred feet of steep snow-covered rock and having ascended a very steep gully, we attempted to gain the arête of the mentioned spur. We were tied in and belaying, using ordinary fourth-class technique. The rock rose quite steeply, but there were good holds. For the most part, the clouds above withheld the view, but during clear moments we caught glimpses of the awesome mountain above us, while through the sea of clouds below a few neighboring summits protruded like islands. It was overwhelming to become aware of the immensity of the mountain; despite my clinging to its flanks in full realization of my relative minuteness, I had a feeling of strength and pride. Perhaps this experience can explain in some measure why, deep down, I am a mountaineer above all else. Although that day, spent with Al Steck, Mingma Tsering, and Gombu was one of failure, it will live as one of the most memorable in my life.

We failed to reach the main ridge. As Al came into Camp IV that night, it became clear that he could not stay much longer in altitudes higher than Camp III. During the night his condition became worse and the following day, aided by me and the Sherpas, he descended to Camp III. There Bruce administered medical aid sufficient to strengthen him for the return trip to Base Camp. Dick Houston, whose condition was little better than Al's, went with him.

Willi Unsoeld and Bill Dunmire, fresh after recovering from dysentery, formed the second team to fight for Camp V. They planned to attempt the face route pioneered earlier by Houston and Unsoeld. They were accompanied by Sherpas carrying most of the gear. The problems which faced this group were complicated by additional snow fall and slight recurrences of dysentery. After their first night at Camp IV, they were seen

working directly above it, where they soon became lost in mists. They accomplished an important task by putting a rope ladder over thirty feet of smooth rock, making relatively easy a section that exceeded the limit of difficulty for loaded climbers. They then returned to Camp IV. Bill had exhausted himself and returned to Camp III next day, passing Gombu, Mingma, Kippa, and me, en route to join Willi Unsoeld for the final attempt to reach the ridge.

At Camp III, Will Siri and Bruce Meyer waited for and worried about every group that ventured above. During these last struggles their lot was to remain camp-bound, to form the support party if needed, and to carry the responsibility for leadership and medical aid for the weary climbers.

When the three Sherpas and I left Camp III on the way up, Will had made it clear that this would be our final attempt. By now we all knew that the summit would never be reached. We were fighting to reach the southeast ridge, establish Camp V, and ascend the ridge as far as possible.

The weather continued to get worse. My notes read: "At 12:30 P.M. we pulled into Camp IV after going through a severe storm and several fair-sized avalanches. We helped Willi Unsoeld remove the debris of the last avalanche from the cave, ate, and tried to sleep."

We rose at six in the morning but did not get away from the cave until nine-thirty although we had made preparations the night before. One factor contributing to our delay was that Mingma told us, just before we started, that his pack was too heavy; to eliminate weight we poured away all but one quart of stove kerosene, which now had to last us two nights. Mingma had carried more than his share of the very large pile of gear that three Sherpas hauled to Camp V; he always had carried extra weight, but even this powerful fellow had reached his limit of endurance.

Willi Unsoeld, with Kippa and Mingma on his rope, started breaking the exhausting track up the 50-degree slopes. Several hundred feet higher, Gombu and I, who were roped together, assumed the lead. Before long we all gathered for lunch atop the rope ladder which had been placed earlier. Warm sugared tea from the thermos bottle constituted the main part of our food.

The terrain here consisted of steep rock with snow-filled ledges and gullies through which we ascended. Poor snow conditions and extremely steep slopes made it necessary to place pitons nearly every hundred feet which made eight falls during our descent relatively safe.

When we passed the high point that Willi and Dick Houston had reached, a break in the clouds showed us the spot where we wanted to put Camp V; this was above and to the right of us, with snow all the way.

Although the route was steep and dangerous, we made it. Eighteen inches of snow fell during the six hours, while we pushed up, and snow continued to fall as the Sherpas erected our two tents. We crawled in and made Camp V, at 23,500 feet, our new home. Soon Gombu poked some hot food through the tent opening. It was difficult for us to swallow, and Willi gave up midway through the instant potatoes and tuna. My reputation as eater par excellence was still holding true even though I had to force myself. Sleep came with sleeping pills for me, but dysentery pains kept Willi stirring through most of the night.

"We are as weak as kittens, though nothing seems wrong with me." This log excerpt of June 2, 1954, sums up our feelings as Willi and I crawled out to start up the ridge above Camp V.

The next morning Gombu joined us as we floundered through waist-deep snow in our feeble effort to ascend the ridge, resting for one minute after each one or two steps. If only the snow had not been so deep and soft! The ridge above, as far as we could see, looked most easy to negotiate. We felt that we had the most difficult section of the mountain behind us. Upon reaching a rocky point nearly 200 feet higher than Camp V we caught a view of Camp III. More important, we caught, ever so slightly, the sound of shouting. The shouts became more intelligible: "Come down, come down!"

Little did those at Camp III realize that we were not capable of going any farther anyway. We had used up all the strength we possessed to get where we were standing. In fact, we had just decided to return. Still we realized that some matter of urgency had arisen. We had forgotten the radio and could not know that Base Camp had radioed the news to Camp III that the rapidly advancing monsoon would arrive in 48 hours. This news prompted Camp III to call to us through megaphones.

So we returned. After a second night at Camp V, we started the long, tiring descent. The storms had added more than a foot of snow at our elevation, and nearly twice that amount at Camp III. Realizing the treacherous quality of the slopes over which we were to descend, we roped in a single rope 200 feet long and moved simultaneously. The rope thus was anchored at one point at least and usually at two points, by pitons. Within the first hundred feet, Kippa's steps gave way, sending him sprawling down the slopes, to be caught by an ice-axe belay. The pitons had paid off. Next man to find himself helplessly sliding down toward Camp III was Gombu. Even Willi fell, a victim of the poor snow conditions and steep slopes. Mingma and I were breaking trail, so the snow remained in place for us. Willi, bringing up the rear, and the two before him were not so fortunate.

The welcome greetings of our comrades at Camp III and the warm Nepali tea prepared by Tashi, the Camp III cook, soon revived us and we could relate a bit of our story before crawling into the tents for the night. Next day saw a great line of Sherpas and Sahibs retreating to Base Camp, beaten by Makalu.

As climbers we failed. Our scientists said that our expedition was a success. We felt grateful that we had been able to make a determined effort to climb the mountain and could return without serious injuries or fatalities. Besides, we haven't given up yet. We hope to return to Makalu at the next opportunity.

[The first ascent of Makalu was made in May 1955 by a French expedition. Although no data have been received officially, it is thought that they made the summit via the northwest ridge, by turning the great step to the east at 26,000 feet.—R.C.H.]

CHRONOLOGY OF THE CALIFORNIA HIMALAYAN EXPEDITION

Dec. 1, 1951—First meeting California Himalayan Committee
Feb. 9, 1952—Expedition endorsed by Sierra Club Board of Directors; establishment of Advisory Committee
March 25, 1952—Expedition endorsed by American Alpine Club
August, 1952—Permission refused for Dhaulagiri (26,795)
Dec. 15, 1952—Permission granted for Makalu (27,790) in 1954
Aug. 1–15, 1953—Testing of food and equipment on Mt. Robson in Canada and ascent of the mountain.
Dec. 27, 1953—Five tons of food and equipment shipped to Calcutta, India
Feb. 18, 1954—Expedition left Berkeley, California, by plane
Feb. 27, 1954—Arrived Calcutta
March 12, 1954—Arrived Biratnagar, Nepal
March 15, 1954—Left Dharan, Nepal, with 250 coolies
April 5, 1954—Arrived Base Camp, 15,500 feet
April 16, 1954—Decision by members on southeast ridge as possible route on Makalu
April 18, 1954—Camp I (16,500 feet) established
April 22, 1954—Camp II (18,000 feet) established
April 26, 1954—Camp III (21,500 feet) established
May 23, 1954—Camp IV (22,300 feet) established
June 1, 1954—Camp V (23,500 feet) established
June 2, 1954—High point reached—23,700 feet (Bill Long and Willi Unsoeld with 3 Sherpas)
June 8, 1954—Left Base Camp for India
June 22, 1954—Arrived Biratnagar, Nepal
June 27, 1954—Arrived Calcutta
July 11, 1954—Arrived Berkeley, California

The Burro and the Family

Editorial Note: Ten entries were received in the Sierra Club's contest for an article about a private burro trip. The prize of fifty dollars was donated by C. M. Goethe of Sacramento. Five entries came from the San Francisco Bay chapter, two from the Angeles chapter, and one each from the Loma Prieta, Los Padres, and Mother Lode chapters. Six of the trips were in the Kings River country. Three were described, wholly or partly, from the point of view of the burro.

The editors decided to split the prize between Melvin J. Voigt and Caroline T. Finch, whose articles are printed together here. Interesting articles were received from Jane and Elmer Aldrich, C. E. Cherry, Barrett N. Coates, Leonard Garfield, Carroll and Sue Glidden, Stan Gould, Alice Jane Hawker, Maurine and Allen Ryan.

Kings Canyon Holiday

By M. J. VOIGT

IT HAPPENED in a few seconds. One minute Lady was picking her way daintily along the trail—the next she was down to her tail in a muddy bog. She put all she had into an effort to fight her way out but the mud was deep and she only made matters worse. Until this happened our first burro trip had been a complete success. The burros had behaved better than, as tenderfeet, we had any reason to expect. Exhibitions of stupidity and stubbornness, traits often attributed to burros, had been demonstrated more often by the humans than by the animals. And now, was this the sad end of a perfect Sierra trip? There was Lady, quivering with excitement and fear. Would we be able to help her?

Fortunately we had spent almost two weeks with our burros wandering through the Kings Canyon country. Removing a pack from a burro was now a matter of seconds and even loading time had been cut in half. We soon learned that worry was unnecessary, for Lady was as courageous and dependable as she had been in meeting every other demand made of her. At a word she stopped struggling and waited patiently with a frightened look that meant clearly, "You led me into this, I hope that you know how to get me out." As soon as her pack was off she knew exactly what to do. With a surge of power and a mighty heave she came out with heels flying and with a shower of mud spattering everything around her. A few kind

words and elimination of at least part of the black, sticky mud and she stopped trembling and could be loaded again. Soon she was ready to continue her methodical trek down the trail. The other burro, known as the Old Man, had waited patiently behind. He was happy to detour the worst spot and with a burst of unusual energy and speed, joined Lady down the trail.

This incident was our only "serious" trouble on the entire trip. We like doing things together and have enjoyed some fine vacations. But on this trip the five of us were having the grandest time we had ever had. The burros, we soon decided, were well acquainted with the country and might have been better at guiding us than we them. It was certain that they knew more about crossing streams. Our first crossing of the Kings River at Woods Creek was painful for me but humorous to everyone else including, I think, the burros. Everyone knows that burros are stubborn about crossing streams. You must beg them, push them, pull them, outwit them —anything up to building a fire under them, to get them across. So, when we reached this, our first major crossing, I took off my shoes and socks. I grasped the rope firmly and prepared to match my strength and wits, first with the Old Man. But he showed less fear of the water than I did. The hard, slippery stones were torture to my bare feet. The Old Man made it all the more difficult for he was soon doing all the pulling and I had no chance to select my footing. Finally we reached the other side and I went back to get Lady, impatient to join her companion. She was in even more of a hurry when I started "pulling" her over. We made it, but the pretense of dignity which I had been trying to maintain was gone by this time. Our rough speedy crossing had one advantage, for it was all over before Margie could get her camera set. For this at least I could be thankful.

From then on the burros forded streams by themselves. Whether or not they realized that it took only one lesson to teach the humans that all that was needed was to fasten the rope on their packs and start them out, we didn't know. We hoped that they were proud of the speed with which we caught on to the fact that in burro management we were the learners and the burros the teachers. It was a bit demoralizing, but in the wilderness one must accept facts. Once we had learned our rightful place we followed placidly their every wish. It seems likely that the two burros enjoyed more attention than they had ever had before. Wherever we stopped, Paradise Valley, Castle Dome Meadows, Rae Lakes, Vidette Meadow, Reflection Lake, they had only to make a sound—they could make some amazing ones—and Lorie or Paul would go running to their meadow to see what they wanted—a little oats, better grass, a drink, or just attention. I sus-

pected that when either of these two decided to stay in camp with their mother while the rest of us went on side trips, it wasn't just to keep her company, or even to go fishing. It was to be near the burros and to see that they had everything they wanted. By staying in camp though, they missed some grand country—for example, the hike to Dragon Lake, the ridge back of it and a fast shale slide back to the lake, or the beautiful short climb from Vidette Meadow up to the rugged, lake-dotted, glacier-polished valley up between the Videttes. A more ambitious hike took us from Reflection Lake up the old Longley Pass Trail, ending in a twenty-foot bank of snow. With some scrambling, we managed to work our way around the snow for a quick peek over toward Cloud Canyon and the Kaweahs far beyond.

There were other attractions in camp than the burros, and we all enjoyed the days we left off hiking altogether. Both fishing and birding had their satisfactions but it's the former which makes my mouth water now. For that matter, who could forget, while they lasted, the biscuits, gingerbread, corn bread, and even cake provided by the reflector oven? We should have taken more mixes along but we had never used a reflector oven before and had no idea that it would work so well. The tastes, the smells, and the scenery all blend together in our memories; breakfasts on Rae Lake with Fin Dome and the surrounding mountains sharply doubled in the lake, lunch among the stately pines or up on a rock with an awe-inspiring view, dinner with the colors gradually shifting in Reflection Lake and the alpenglow lighting all the peaks. Every minute was exciting. A family vacation difficult to surpass was made possible, we realized, by our burros and their ability to get us where we wanted to go.

Now another summer beckons. Another part of the Sierra? Probably. There must be dozens of areas as fine as the Glen Pass circuit. We want to see more of the Sierra, but if we start somewhere else we will have no chance of employing the same teachers in the way of the trail, Lady and the Old Man. It looks as if we will have to go back to the Kings again. We might go up Bubbs Creek to Foresters Pass and perhaps even on to Whitney. Or, we could try Granite Pass and the Middle Fork of the Kings, or Sphinx Creek and Cloud Canyon. It will take a good deal of talking to decide, but we are sure of one thing: It will be a burro trip, and if Lady and the Old Man are available we will greet them like old friends.

The Children Loved Them

By CAROLINE T. FINCH

On Tuesday, July 6, 1954, our family of five joined the Burro Wrestlers' Club. Barbara, age 2½, joined reluctantly. We had taken her on trial pony rides and even on a trial burro ride, but sitting on a small saddle felt much more secure than being perched on top of a 60-pound pack. She resolutely refused to stay on her burro and began walking over Kearsarge Pass beside daddy. Brother Richard was pulling the black burro and mother was being pushed up the trail by the white one. Sister Delsie, being an old hand at this type of activity, was already a half mile ahead of the rest. After trudging along the trail for a very short time, Barbara consented to ride her steed. We stopped the procession and set her on the burro—but as soon as he started moving she began feeling unhappy again. We remedied this condition by singing her favorite tunes, and after she had tearfully joined us in several verses of "Oh Susannah" and "The Farmer in the Dell" she soon forgot herself enough to try rocking the pack back and forth. We explained that this was just like riding on her little red rocking horse at home, only much more fun. We did discourage the rocking of the pack though, feeling it a bit unfair to the burro.

When we first began talking Burro Trip during the winter rainy season we decided the only way it could be done harmoniously as a family group was to plan on traveling slowly and letting each day unfold as it arrived. We (which means mostly my husband) pored over topographic maps, and we had a general though flexible plan of travel. My husband had done some backpacking and had taken burros once during his boy-scout days. I had gone on one backpack trip (short) with him and had seen enough of the high country to know I would enjoy being able to spend more time there. We read and reread the Sierra Club publication *Going Light—With Backpack or Burro* and found it a great help.

There are three wonderful stages to any mountaineering experience. Each is as exciting as the next one. First is the planning stage. We took about six months to plan ours and loved every minute of it. We went over food and clothing lists with new inspiration each time. We did have to watch the weight of our gear which resulted in a marvelous invention. We allowed ourselves the luxury of air pillows (our mattresses weighing too much), and discovered they were almost as good as an entire full length air mattress. If we hollowed a place in the ground at hip level, put the

slightly inflated air pillow there, we had the next best thing to our own innerspring.

The second stage is the actual trip. I can't say enough about this part. Aside from the beauty of the country, we found our family was really a family once again. There were no telephone calls, no meetings to which we needed to rush, no house to keep in order, and on and on I could go with this list. We had a family campfire each evening. Richard, ten years old, insisted on being master of ceremonies. We had songs and skits and even little Barbara caught the spirit of it and had a great time. The family operated as a working unit. Each member had certain duties to perform and being alone with ourselves made even the youngest aware of their importance, and their responsibility to carry through.

We provided whistles for Barbara and Richard, thinking they could sit down and blow them if they lost sight of us. We had no need of them, and the only time we heard the whistle was when Richard fell in the river while he was fishing.

We spent one exciting night at Vidette Meadow. A forest ranger was camped up the creek from us with a horse and mule which he turned loose at night. They had bells which rang out all night as they tramped around our camp. It was quite an experience because we were all lined up in our sleeping bags right under the trees. It seemed certain the animals would stomp right over us. However, they left the next morning. The second night there, we were conscious only of the rustly trees and the water splashing down Bubbs Creek. I can't imagine a more peaceful feeling.

We camped one night at Center Basin where the first flowers of spring were showing their bright faces. What a thrill it was to waken in the night to find such absolute quiet. Not one solitary sound to be heard, the moon shining down on our camp, and a solid wall of rock surrounding us. I was reminded of a verse from Psalm 8: "When I consider thy heavens, the work of thy fingers, the moon and the stars, which thou hast ordained; what is man, that thou are mindful of him?"

In some manner we had received the very false impression that caring for burros was going to be a lot of bother. We had heard they were too slow, a trouble to feed, kept one from going where one might want to go, and so forth. We found none of these things to be true. I can't think of a better method for a family camping trip. The children loved them. They shared their candy and oatmeal with the animals, helped pack and unpack them, and spent our lay-over days sitting on their backs or just admiring them.

Now we are just getting into the swing of the third stage of our experi-

ence—enjoying our trip in retrospect. We took a few colored slides, and any time we have a captive audience out come the projector and screen. I know we will never tire of seeing the slides and recalling the great fun we had together on our first of many burro trips.

If any family has any hesitancy about taking a burro trip I must say that their fears are groundless. If one member of the family has the enthusiasm to take the first step, if you have tried a public-camp type of camping and find you enjoy doing that, then a burro trip will hold even more fun for you. You will return home with a much greater knowledge of our beautiful High Sierra, and most important of all, you will have a fuller realization of the meaning of family unity.

There was one element which we found distressing. There was a litter of wine bottles, cans, papers, and even opened boxes of food in some places. We had great fun seeing just how clean we could leave each camp. We soon discovered that burning the cans (just as the books say) makes it easy to flatten them for the garbage pit. And, oh the garbage pits! How any thinking person can make the effort to get into the high Sierra country and then treat it with so little respect is something I'll never be able to understand. Each camp had its garbage pit with its cans not smashed, not burned, not even buried.

The High Sierra is a grand and beautiful area. Let us preserve its natural beauty by educating our children to love, respect, and care for it. We have a 2½-year old who now will not throw away even a gum wrapper. We have a 10- and a 15-year old who have the satisfaction of knowing that they left each campsite in a better condition than when they found it. We feel our burro trip was a two weeks' course in visual education, and among the many things we brought home is a deeper value and appreciation for our great country.

Who Discovered Rainbow Bridge?

By WELDON F. HEALD

On my desk is a statement which contradicts the claim that John Wetherill and his party in 1909 were the first white men to see southern Utah's famed Rainbow Bridge. The statement was dictated by William Franklyn Williams at Winslow, Arizona, May 22, 1929, and typed by his daughter, Bernetta ("Billie") Yost. In it he describes two trips he made to Rainbow Bridge in 1884 and 1885. But he makes no claim to being its discoverer, for he states that he found evidence that other white men had been there before him and he gives the names of some of them.

This statement runs counter to one of the most widely publicized discovery stories in Southwestern history. The account of the Wetherill-Cummings-Douglas party's visit to Rainbow Bridge has been told and retold until it is almost as famous as the great stone arch itself. Furthermore, so far as I know, no one has ever questioned that they were the first white men to see the bridge; during my thirty years of acquaintance with the Arizona-Utah canyon country, only once did I run across the shadow of a doubt, when I read in Freeman Tilden's *The National Parks*, published in 1951, "the first white men, *it is believed,* to look upon this stupendous arch . . . ." (The italics are mine.)

The usual account varies in some details, but the essentials are well documented and are stated as follows in a booklet of the National Park Service:

"The existence of this natural wonder was first disclosed to Prof. Byron Cummings, then of the University of Utah, in the early summer of 1908, by Mrs. John Wetherill, who related to him vague descriptions she had obtained from a Piute Indian. During the winter of 1908–9 Mrs. Wetherill found two Piutes, Nasja and his son, Nasja-begay, who actually had seen the bridge. Acting upon Professor Cummings' request, Mrs. Wetherill engaged these men to serve as guides for the following summer. Under guidance of John Wetherill and Nasja-begay, a party consisting of Professor Cummings and three student assistants, and W. B. Douglas, surveyor of the General Land Office, and his four assistants, reached the bridge on August 14, 1909—the first white men to behold this most colossal of known natural arches. The following year, on May 30, 1910, it was made

a national monument upon the recommendation of Mr. Douglas. It embraces an area of 160 acres."

This story stood unchallenged for forty-five years and it seems incredible that any claim of earlier discovery would not have reached public notice during this time. At any rate, the Williams statement deserves investigation. Here it lies before me. I can't dispose of it by throwing it in the waste basket.

I first heard of Williams's early visit to Rainbow Bridge in the summer of 1954 when I read a manuscript entitled "Bread Upon the Sands" by his daughter Billie. Unpublished as yet, the book vividly describes her life as a child, teen-ager, and young lady at Red Lake Trading Post on the Navajo reservation, forty-five miles northwest of Winslow, where Williams was licensed Indian trader from 1914 to 1929. Billie certainly knows her Navajos, speaks their language, and has written some fascinating chapters on their customs, habits, social life, and the varied experiences of a trader's family living among them.

But it was the chapter on Rainbow Bridge that made me sit up. In a matter-of-fact manner Billie retold her father's account of his visits to the bridge more than seventy years ago with her grandfather and her uncle, Benjamin Williams. There was no controversy, no belittling of others' claims, or even mention of the Wetherill party. The casualness with which the three Williams's wanderings in the canyon country was reported indicated that seeing Rainbow Bridge was unimportant. What mattered was the discovery of a gold or silver bonanza.

I decided to look into this and got in touch with Billie when my wife and I went to Flagstaff in June, 1954, as co-directors of the annual Conference of Southwest Writers and Writers' Workshop at Arizona State College.

We had known Billie casually for several years as Mrs. Ernest Joseph Yost, and knew that she had been with the *Coconino Sun* and *Arizona Daily Sun* for eighteen years as a reporter, society editor, and comptroller, and that she was recently appointed assistant publicity director of the College. But we had never heard much about her life on the Navajo reservation nor about her family.

"They were Indian traders," Billie told us. "Records at the Bureau of Indian Affairs in Washington show that my grandfather, Jonathan Paul Williams, erected the first trading post at Blue Canyon in 1882, and my father and two uncles were all in the business."

"Were they native Arizonans?" I asked.

"No," said Billie. "Grandfather was the first white child born in Marys-

ville, California, during the Gold Rush of 1849. All his life he had the gold fever, and he was killed in Mexico still looking for his Big Find which was always around the next corner. In fact, that was why he came to Arizona."

"When was that?"

"In 1878 when father was eight years old. The whole Williams family migrated by wagon train. Jack Carson had told grandfather about a rich mine near Navajo Mountain. But he never found it, although he searched for years." She added, "Grandfather, father, and Uncle Ben were looking for this lost mine when they saw Rainbow Bridge. But it wasn't known as that then—they simply called it the stone bridge."

"Had they ever heard about it before they went there?" I asked.

"Oh yes," said Billie. "Grandfather had often heard trappers and prospectors tell about the big stone bridge, and Hosteen Hoskinney knew about it. He was the Navajo guide on their prospecting trips."

Then I asked, "Can you tell me anything your father said about the bridge? Was he surprised or impressed?"

"He never said much except that they didn't think anything of it. They took all the wonders of the Southwest in their stride. It was part of the new country and nothing ever amazed them. They never knew what they would find next."

I asked about the evidence that white men had already been there before them.

"They found names cut on the free end of the arch, also some more names written in charcoal on the cliff walls farther down Bridge Canyon." She referred to her father's statement. "The names he definitely recalled were those of Billy Ross, a man named Montgomery, Jim Black, George Emerson, Ed Randolph, and another man named Wydel."

"Did he know who these men were?"

"He mentioned a couple of them," Billie said, then read from the statement. " 'Billy Ross was known as Bill A. Ross, W. A. Ross, William Albert Ross, and Buckskin Billy Ross. Jim Black was A-One Jim Black, known so in Flagstaff because he punched cattle for the A-One cattle outfit in Fort Valley.' " She looked up. "They were all prospecting or trapping at the time."

I asked if her father thought these men visited the bridge in one party or at different times.

"He thought the names had been carved there at different times, because some of them were weather-worn, others more fresh. He was sure they wandered in there one or two at a time and not in a party."

I kept thinking of those carvings. "I've been to the bridge twice myself, and I've certainly seen no sign of anything like that and never heard about them," I said. "How do you account for their disappearance?"

"I don't know for sure," said Billie guardedly, "but a friend of mine went to Rainbow Bridge in the 1920's and told me the names had been purposely obliterated."

"Obliterated!" I exclaimed in surprise.

"Yes. He said you could see where they had been taken off. It would be easy, you know. It's soft sandstone."

"Who do you think did it?"

"I couldn't say," said Billie.

That was that. So I asked my sixty-four-dollar question. "How do you account for the fact that your father's prior claim never got any publicity and after all these years nobody seems to have heard of it?"

Billie didn't answer directly.

"I tried to get a radio station to do a story on it, but they weren't interested. Said the Wetherill party made the first official discovery and that satisfied them. Then a writer friend of mine peddled an article on it for several years, but he said it didn't sell."

"But John Wetherill was a neighboring Indian trader up at Kayenta. Didn't your father ever say anything to him?"

"I don't think so," said Billie. "They weren't at all close." She continued. "You see, my father and grandfather were not the first white men to see the bridge. Father always said it was some lone prospector or wanderer who really saw it first. When he learned of the Wetherill-Cummings-Douglas claim he only laughed and said, 'Why I saw that bridge twenty-five years ago with Dad and Ben.' And then he told us the story. Neither he nor Uncle Ben seemed to care if others claimed to be the first white men to visit Rainbow Bridge. They *knew* it wasn't so, and let it go at that."

"Billie," I said finally, "this information is so interesting that I'd like to give it publicity just as it stands. May I borrow your father's original statement?"

"Of course," she said. "But take good care of it because I prize it greatly."

"Tell me just a little bit about your father; then I'll let up," I said.

"Well, he was a pioneer Westerner and he had very little formal education. However, he was smart in the ways that matter in the West and in the desert country. He was a square-shooter—the most honest and straightforward man I have ever known, and all his friends said the same thing about him. Both my father and mother were killed in a head-on

automobile collision on November 10, 1940, while en route home to Winslow after spending a Sunday afternoon with me here in Flagstaff. You will never know how badly I felt, for I always think that if they had not come to see me it would never have happened."

We sympathized with her, then I asked, "Your Uncle Ben is dead too, isn't he?"

"Yes," said Billie, "he died in 1943 or 1944, during the war sometime."

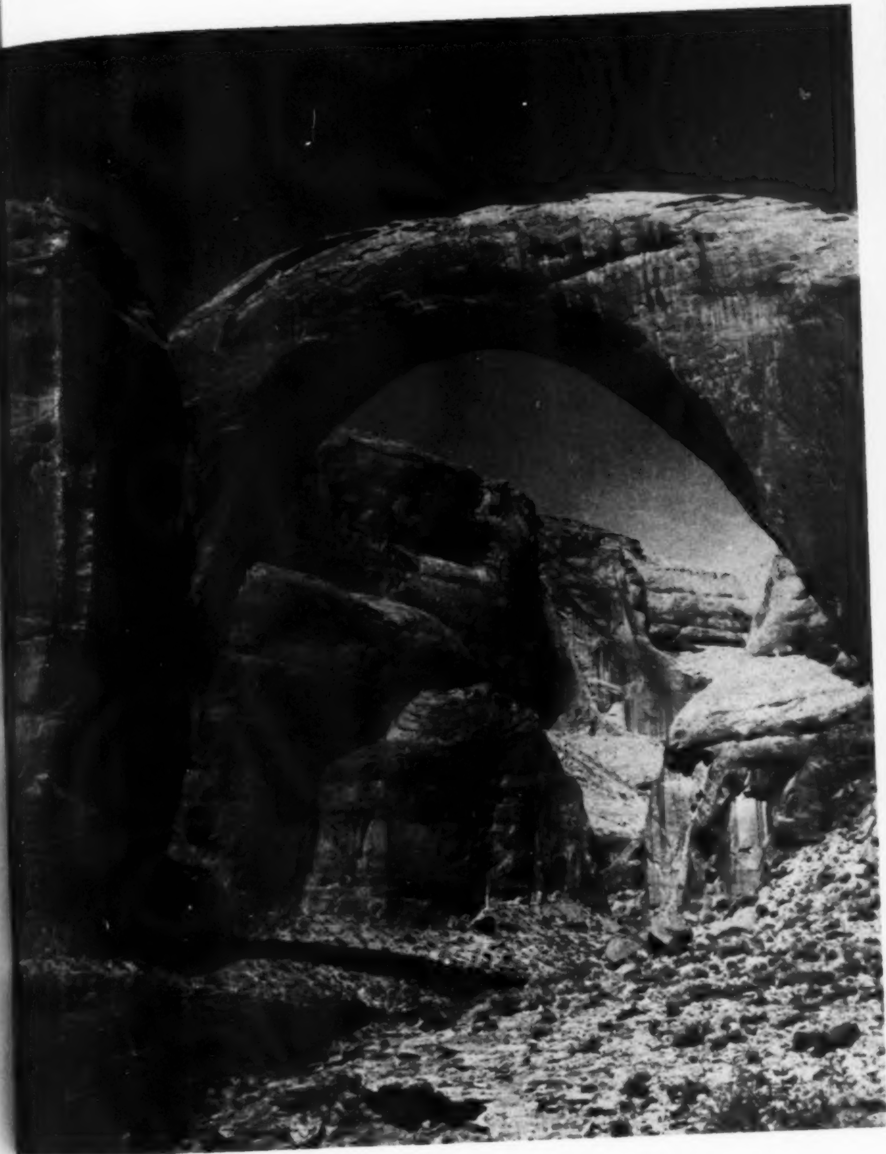
So now we have only William Franklyn Williams's statement—seven legal-sized pages of double-spaced typescript. Little of it actually deals with visits to Rainbow Bridge, but it contains a detailed account of wanderings in search of gold or silver through the maze of canyons north, northwest, and west of Navajo Mountain. The complicated topography is accurately described and there isn't a doubt that Williams was thoroughly familiar with this rough desert country.

The report begins with the statement: "I saw Rainbow Bridge in 1884 in company with my father, J. P. Williams. Hosteen Hoskinney went with us, as he said he could show us where the silver prospect was that had been worked by Merrick and Mitchell." On page 6 he says: "The first time I saw Rainbow Bridge it was about the 20th of November 1884. The next year Ben and I went with my father around the 15th of February."

On these trips Williams mentions visiting every important canyon, butte, and mesa, as well as many side canyons. They saw Owl Bridge and other natural arches, climbed Navajo Mountain, and prospected along the San Juan River. He relates that they had no trouble taking their horses through what is now known as Redbud Pass, and that Nasja, the Piute chief, had been keeping his stock in Bridge Canyon, then known as Under-the-Arm Canyon, in the vicinity of the great stone arch for many years.

Although Williams was only fourteen and fifteen years old at the time, he lived in a self-reliant pioneer age when boys became men early, and his statement has the ring of authenticity and truth.

So here is a faded signpost pointing down a trail into the past that would be fascinating to follow to the end. I am not a historian—just interested in the canyon country and the men and women who have lived there. But I am curious enough to hope that this account will stimulate some qualified researcher to take this trail back into history and tell us who was the discoverer of Rainbow Natural Bridge—and when?



Southern Utah's famed Rainbow Bridge was supposedly first seen by white men in 1909. But strong evidence exists that it was visited by several prospectors and trappers as long ago as 1884. *Photo by Weldon F. Heald.*

William Franklyn Williams, standing, signed a statement that contradicts the story that the Wetherill-Cummings-Douglas party were the first white men to see Rainbow Bridge. He found evidence that others were there before him. This picture of him, his father, who also went to the bridge, and his sisters was taken in Winslow, Arizona, in 1890 or 1891.

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Alabaster Cave, 1860 (after Hutchings) *(upper left)*	*Bancroft Library reproduction*
Alabaster Cave, 1953 *(upper right)*	*Harold Treacy*
Straw Room, Lost Soldier's Cave *(lower left)*	*Harold Treacy*
Needle-like anthodites *(lower right)*	*George Mowat*

Lehman Caves, Nevada

Courtesy White Pines County Chamber of Commerce

Lehman Caves

George Mowat

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The Underground World

By RAY DESAUSSURE

WE COULD dynamite every cave entrance in California—a drastic step, but from the point of view of cave protection perhaps preferable to our present policy of abandonment and nonprotection. At least, future generations would then have their own opportunity to judge the value of still-existing cave resources which would otherwise remain only as memories in the dust of libraries. I do not advocate dynamiting. I rather propose the milder form of protective policy that will permit our caverns to be enjoyed; in keeping with that policy, only the location of protected caves will be mentioned in this article.

There are five types of caves, all found within California.

The first and probably the least spectacular, is the erosional cave—sandstone cavities and other similar small rock shelters. These wind-scooped depressions may be found dotting the countryside almost anywhere. Formerly they provided shelter to nomadic Indians. The chance shadow on the mountain that catches the eye while we drive along the road generally indicates a cave of this type.

The sea grotto, considered by some an erosional cave, forms a second type. It is true that it developed partly through the grinding action of sand and gravel flung by a pounding surf; still, the major reason foı its development is the action of strongly compressed fluids, as in a blowhole. The energy inherent in the rise and fall of the swell inside a small crack produces a sudden and powerful force on the air and water contained in that crack. Gradually, the alternating compression and decompression convert minute cracks into major fissures and the grotto forms.

As a coastal state, California is rich in such grottoes; some are easily accessible, as the La Jolla sea caves, with seven principal openings and many smaller ones, some penetrating hundreds of feet. One of the world's longest sea grottoes, Painted Cave, is situated on Santa Cruz Island off the Santa Barbara coast, but is not now accessible to the public.

The talus cave, the third type, is usually small, since it consists only of the chinks and holes between large pieces of rock. If we proceed to any depth, the action of running water together with pressure and earth movement tends to close the cave. Consequently, most talus caves are relatively near the surface of the earth, and frequently have several entrances

through the rocks and boulders forming the cave system. The caves of Pinnacles National Monument are characteristic and readily viewed.

The fourth type, especially represented in northern California, is the lava tube. Such caves are the solidified shells formed by molten lava pouring down the flanks of volcanos which is hardened externally by the cool outside air. The fiery liquid centre that is protected from this cooling frequently builds up sufficient pressure to burst through the thin wall; the lava then continues its journey to form an extension of the cave by a similar process. Long hollow cylinders of almost constant cross section are the usual result, and numbers of these may be visited in the Lava Beds National Monument. Some are of great size and beauty.

The final type, the limestone cavern, is the largest and most interesting. Only here may be found the various sculptured and fluted forms so commonly associated with caves. This is the cave most vulnerable to the specimen collector, the name writer, and the vandal. From its ceiling hang the delicate snow-white straw stalactites, and from the floor to meet them rise the massive dripstone stalagmites. Writhing from the walls in Medusan patterns are the enigmatic helictites, crossing and entwining in forms which have long been a subject of controversy. Innumerable other forms, more generally termed speleothems, cling gracefully to the arched tunnels, or rise from the terraced floors; cave coral, the universal lining of many caves; shields, a rare circular or oval plate growth; rimstone terraces, delicate deposits that turn the cavern floors into miniature rice fields; oölites or cave pearls, produced by continually rotating grains of sand or rock in small pools. The list is lengthy, and new forms are being discovered and observed continuously.

In northern California, Moaning Cave and Mercer's Caverns, both in the Mother Lode region, may be visited readily and many of these forms observed; similarly in the southern area, Boyden's Cave and Crystal Cave are easily accessible.

There is a good reason for the development of limestone caverns to such tremendous size as in the main chamber of Moaning Cave. The limestone in which they are situated is attacked by acids such as the carbonic acid that results when carbon dioxide dissolves in water, and can be carried away as soluble calcium bicarbonate. This dissolving action, either by standing or running water, forms the cavity. Later, the solution loses both carbon dioxide and water, primarily by evaporation, and the limestone precipitates and redeposits in a more crystalline form. In brief, the dissolving action allows limestone caverns to attain their size, and the redepositing action allows them to attain variety and delicacy.

The creation of caverns is a slow phenomenon, comparable more to geologic processes than to any organic growth rate—even that of the redwoods. As an example, an active cave was found to have a maximum growth rate, at one point, of one millimeter of deposit every 29 years, and yet this cave has a dripstone stalagmite over eight meters high. The rate of growth varies widely among caves, so that some systems are relatively recent while others are of great antiquity. Caves are known to date back at least to the Pleistocene age, and are probably far older.

I will make one exception to my policy not to give specific locations of unprotected caves, because I wish to present an example of total vandalization—the Alabaster Cave, also known as Coral Cave, El Dorado County Cave, Rattlesnake Cave, and Mormon Island Crystal Cave. As it has been totally vandalized, there is no longer any point in attempting protection, and it may serve some purpose as impressive proof of the wreckage that can be and has been accomplished.

The cave may be reached by proceeding from the Old Auburn Post Office on Sacramento Street in Auburn seven miles toward Pilot Hill (in the direction of Folsom). The cave is in a large quarry on the left side of the road just beyond Rattlesnake Creek.

This cave, first discovered on August 19, 1860, is being reduced by quarrying and will soon be destroyed. At one time Alabaster Cave was one of the most renowned attractions in California, and an examination of the earlier tourist travelogues reveals the extent of its fame. Authors such as Hittel, Whitney, Crofutt, Hutchings, and Bancroft knew and wrote of the wonders of the Alabaster Cave. Book after book, article after article relate nature's splendors here exemplified, and declare the cave to be unequaled throughout the West.

Examine that cave today. One finds barren limestone walls, the shattered stumps of stalagmites and columns, and jagged scars marking the former location of snowy stalactites and transclucent bacon-rind formations. Even the floor itself has been torn and smashed with sledges, probably to obtain flowstone souvenirs, or perhaps merely to satisfy some vandal's curiosity as to its composition. One marvels that even the walls are left standing, and then on reflection may wish that they were not, and that all traces of this desecration could be removed.

Now, turning to the problem of cave conservation, we find two categories that need particular protection, namely, the cave of any type which has scientific value, and the limestone cave that is a public attraction. Of course, *all* caves need protection; the sea grotto is perhaps the only continually self-protecting cavern.

Caves containing scientific materials are of value for their archeological and paleontological remains, which are often unusually well preserved in the unweathered constant-temperature conditions that prevail underground. They are most vulnerable to the pot hunter who raids these archives for the occasional souvenirs they may yield, ignoring and destroying the relation and sequence of the data. Such persons seem closely related to those who will tear an illustration from some rare book.

It is only too clear how readily the delicate interior of the limestone cave may be wrecked. Unprotected, it has the fragility and life expectancy of a china shop in the midst of a looting mob bent on destruction.

To illustrate the problem of conservation, let us examine some typical examples and the manner in which they have been handled.

Cave A: This cave, in the southern part of the state, has not been known long. It contains some of the most outstanding examples of certain speleothems. In recent years the knowledge of its location has rapidly spread, and now the cave is in danger of destruction by vandalism. Extensive rope work is required to enter, but this has proved only a slight deterrent. Since it is impractical to develop this cave commercially, a gate should be placed at the entrance, with the key to be retained by those in charge of the property. Some supervision will still be required to watch that the gate is not broken or removed by vandals attempting to enter. Knowledge of the location should be restricted.

Cave B: This cave, also in southern California, contains as the lowest chamber an immense beautifully decorated room. It is well guarded by nature, and access is almost impossible without highly specialized equipment and favorable weather conditions. The lower part of the cave can possibly be reached and opened to the public by an artificial passage. Enlightened commercial development should be encouraged wherever possible, for this affords protection to the cave. A gate placed on this cave can serve to protect it temporarily.

Cave C: This cave, formerly, a great public attraction in the Mother Lode, still has commercial possibilities. The owner of the land on which the cave is situated has made a habit of restricting entrance to the grounds except for special study purposes. Unlike most caves known in the earlier history of the state, this cave has been but slightly damaged by vandals; it would be possible to convert it into a state park. At present, this cave requires no further protection.

Cave D: This small sandstone cave on one of the Channel Islands contains valuable archeological material, well worth investigation, and well adapted to such study. Unfortunately, publication of the site location was

made before exploration was completed, and a large part of the work that had been done was wrecked in a single afternoon by pot hunters, who dug up a large area searching for artifacts. Several artifacts were later found discarded along the road. The excavation has now far progressed, but no further information will be given until it is complete. Restriction of data would have been the most valuable means of protection, but more severe penalties against pot hunting would have assisted also.

These examples illustrate the basic types of cave protection—gates or physical barriers, appropriate commercial development, owner protection, and natural protection. Over a long period of time education may be successful, but it is a process that must be carried out slowly, because careful balance is required for the publicity which such education receives. Too little, and, in time, ever-present vandalism will destroy the cave; too much, and the cave location becomes a matter of general interest and knowledge. Methods of education include articles written on the subject, and continuing scientific studies aimed at a better understanding of caves. Many branches of speleology are meeting with rising interest. Aside from their recreational aspects, caverns are of increasing value to students of archeology, biology, geology, and hydrology. The increased interest can be a potent force either toward cave destruction or cave preservation. In particular, it can be a preservative force if an over-all science is made of speleology, and the contributing sciences are coordinated.

Legislation may be attempted also, but action must be applied with attention to psychological effects, frequently quite different from the original purpose. As an example, it was mentioned that stringently enforced laws—now nonexistent—against pot hunting would aid; however, if that idea were extended to include legislation against the sale of cave specimens, it could result in increased demand for such specimens and the creation of a black market more damaging to the caves than existed before such legislation.

Anyone interested in cave conservation can help not only by refraining from vandalism on his own part, but also by encouraging others not to write on the walls, destroy formations, or do other damage. He can also encourage protection in the form of suitable commercial development, and in the placement of gates where immediate development is not practical. Recreational resources will undoubtedly be in great demand in the future. The attention of conservation societies should be called to caves with possibilities of recreational development. If these resources are guarded today, they will still be available tomorrow—and not mere symbols of vandalism like Alabaster Cave.

American Andean Ascents, 1954

By RICHARD K. IRVIN

THE CORDILLERA BLANCA, or White Range, of northern Peru, one hundred miles long and thirty miles wide, rises in one 15,000-foot sweep from the verdant Santa Valley to an icy 22,000-foot crest. The attractions to the mountaineer are numerous, because these are the highest mountains on the earth outside Asia, and many of them are as yet unclimbed. The weather is superb, the range is easily accessible, and the peaks vary from as easy to as difficult an ascent as one could ask. The existence of these splendid mountains is reason enough for many an expedition such as ours.

The American Andean Expedition of 1954 was composed of eight men who traveled to Peru solely to climb. We had, as Tilman has said, "no damned science." The names of these men are Dr. Fred D. Ayres, Dr. George I. Bell, A. E. Creswell, Richard K. Irvin, W. V. Graham Matthews, David Michael, John C. Oberlin, and Leigh Ortenburger. There were no beginners in the group; six had climbed in Peru before; the average climbing experience of the eight was more than ten years. The expedition was leaderless, and no leader was found necessary.

April saw our 3600 pounds of food and equipment under way for Lima, to be followed in early June by the advance party of Ayres and Creswell. The main contingent arrived in Lima June 15 to find everything in an unprecedented perfect order—so much so that they were able to join the advance party in Yungay by the following night. Two days of rapid and occasionally wild sorting and packing found us ready to enter the mountains. We had grown by the addition of four porters, and the equipment pile had swollen to more than two tons—it was quite impressive. The porters were Eliseo, Euhenio, Felipe, and Miguel; they had all been on one or more expeditions previously.

We left Yungay during the small hours of June 19, and reached the site of our base camp at noon on a cloudy, almost rainy day, one of the worst days we encountered during our two-month stay. Base camp was located at 13,000 feet in the upper end of the Quebrada Yanganuco, an unusual half-scale Yosemite-type valley. Here we felt the first effects of *sorroche*, or altitude sickness, as we spent the next two days in preparation for our first climbs. We planned to begin on the small peaks, so that we could gradually acclimatize ourselves to the higher altitudes, and accord-

ingly our first ascent was to be Yanapaccha, the smallest peak in the area. First a trail, then steep grassy slopes, led us to the discovery of a fine campsite among the boulders at about 16,000 feet. The porters returned to base camp, and we were left to prepare for tomorrow's climb.

Dawn's steely blue promised a fine day as we made the crossing of the glacier plateau at the foot of Yanapaccha's north face, and commenced the final climb on the face itself. At noon we were crawling onto the summit crest, exhausted by the 18,000 feet of altitude. We found the crest itself in a highly dangerous state, with the snow on the south side soft and at a high angle, while the whole ridge was badly corniced. The true summit was fifty yards away and thirty feet above us. Ortenburger began the lead with two climbing ropes tied together. He was soon involved in some hip-deep snow overlooking the southern drop-off, and he became immediately concerned when the snow cracked and settled. Those of us not in his position urged him on, and with Creswell providing an intermediate belay, he reached the precise mathematical top. Again the snow groaned and settled under his weight, so without further delay we beat a hasty retreat. The descent was uneventful, but the following day a section of the summit ridge broke away, and the resulting avalanche obliterated 1,500 feet of our footsteps. This was the first ascent of Yanapaccha.

Our next objectives were Nevado Pisco and the east peak of Huandoy. From an advance base camp at about 15,000 feet the route followed that of previous climbers across Cook Glacier's jumbled moraines and ice walls to Laguna Camp at 16,000 feet. Continuing up a rock rib and a small glacier we found no difficulty in placing high camp at 17,200 feet on the Pisco-Huandoy saddle. Michael and Ortenburger chose to try the rib route on the east face of Huandoy, while the others were to ascend the easy western snow slopes of Pisco. Easy the snow slopes were—a veritable highway—until a point only twenty vertical feet below the summit, where the way was blocked by an overgrown crevasse extending the entire width of the slope. Two hours and two hundred feet of rope later, Ayres stood on the summit, but there was not time enough remaining for the rest to follow and still return to high camp by dark. Michael and Ortenburger had found the rib on Huandoy plastered with ice and soft snow, but had managed to ascend two-thirds of its length before being halted by the difficulties. They returned to camp just at dark, mumbling something about "cardboard belays." Two more attempts to climb Huandoy by the north ridge were stopped by wind and snow, and with fresh snow piling up at camp and on the peaks we decided to return to base camp.

Five days of living and climbing above 17,000 feet had greatly assisted

our acclimatization, and we now felt ready to attempt Nevado Chopicalqui, whose 21,000-foot summit ranks fifth in Peru. Chopicalqui's summit had been reached once before, by a German party under Dr. Kinzl in 1932. Ayres and Irvin, who had drawn the democratic long straws, formed the advance route-finding team. They established Big Boulder Camp at the limit of timber, and two days later Icicle Camp on a rocky ledge at about 16,800 feet. By July 9 all eight climbers and four porters, with the necessary supplies and equipment, had occupied Icicle Camp. On July 10, Ridge Camp was placed at about 18,600 feet on the west ridge of Chopicalqui—all eight climbers were present and in top form. We began the final climb at the crack of dawn the next day; the morning was bitterly cold and our hands and feet ached from it—we had to stop once to revive Michael's numbed feet with a chemical heating pad. The climbing was nontechnical, merely plugging steps in ten inches of cold powder snow, with an occasional traverse to left or right out around a schrund wall. At one o'clock we reached the base of the final 60-foot ice cap. After a fine bit of climbing in steep soft snow by Bell, we reached the summit at 2 p.m. It was the highest peak that any of us had ever ascended. A sea of clouds shifted about below us and largely obscured the view, but fourteen cameras clicked away undaunted. The descent of the ridge, which was softened by the late afternoon sun, was an occasion for alertness and numerous belays over the more precipitous parts. We arrived back in Ridge Camp with high spirits exactly twelve hours after our departure. Two days later we had returned to base camp and were occupied with our favorite outdoor sport — eating. Opening gambit was made by Michael, who cooked spaghetti, and a wild competition ensued.

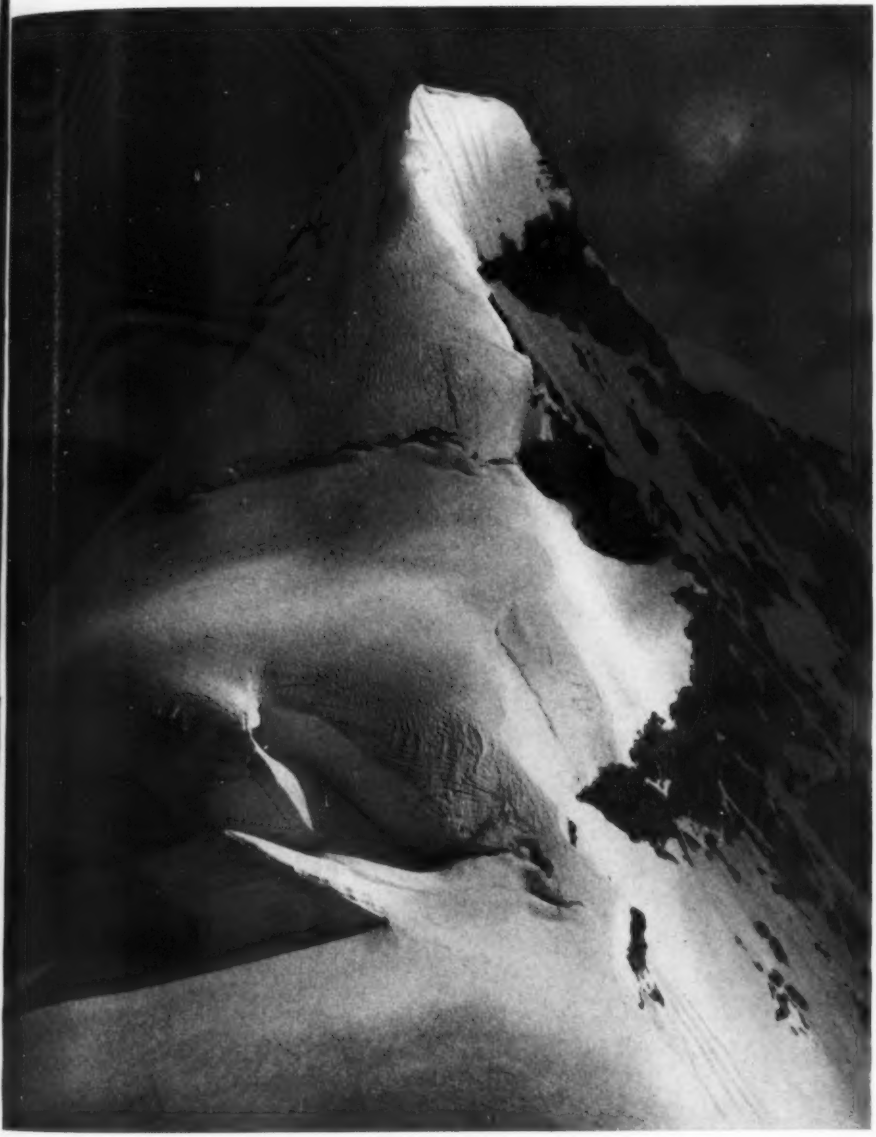
Thoughts of further climbing outlined the need for a feasible route on one of the two principal mountain masses near us, which were the main Huandoy group and Chacraraju. The Huandoy group consists of three high and beautiful summits interlocked by a glacier plateau. From the plateau all three summits should be easily accessible. The north and highest of these summits was climbed in 1932 by Schneider, who reached the plateau via a route on the north side of the eastern icefall, going through at night with what he termed "extreme reluctance." Six ridges descend from the three peaks, and of the six only one displayed any promise, namely, the west ridge of the south peak. Creswell, Matthews, Ortenburger, and Felipe departed on a four-day reconnaissance of that ridge. Ayres, Bell, Michael, Oberlin, and Miguel sallied forth on the same day to explore possibilities on Chacraraju, while Irvin and Eliseo journeyed by trail over the Puerto Chuelo pass, a 15,000-foot trade route.

DAVID MICHAEL AND GRAHAM MATTHEWS DESCENDING CHOPICALQUI (20,998)

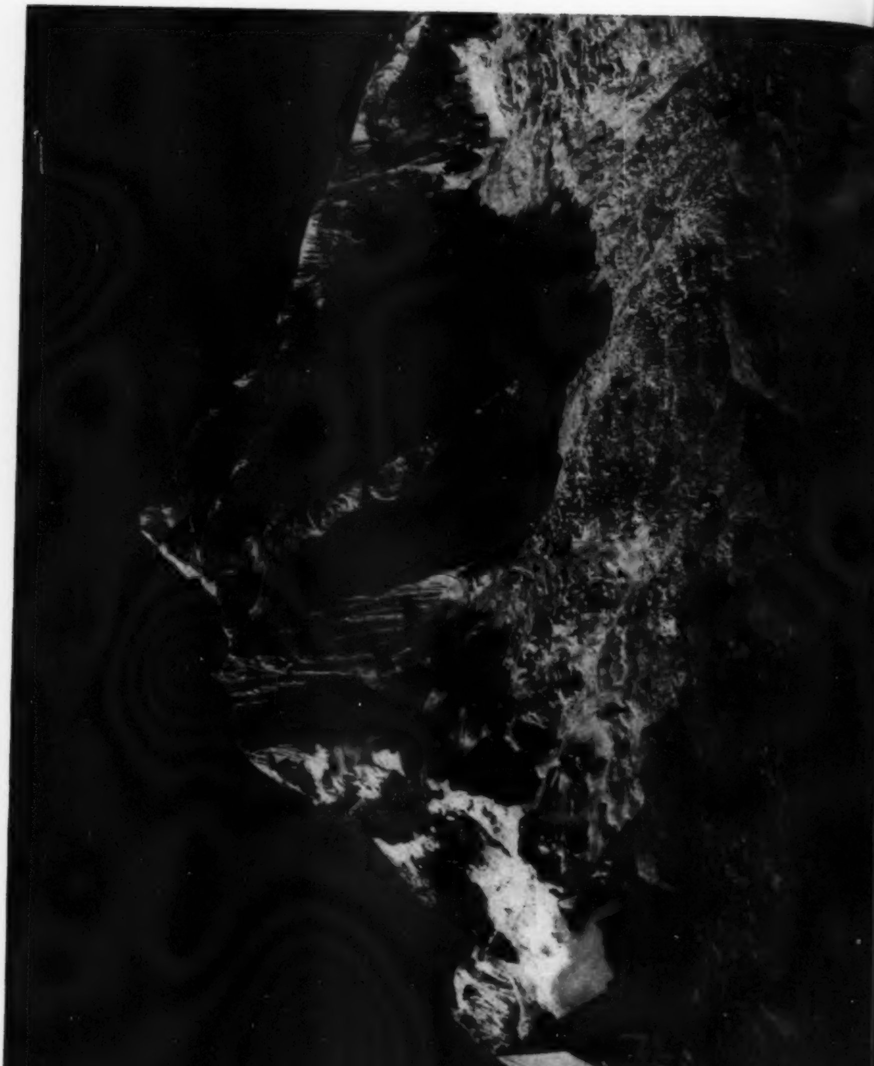
Cordillera Blanca, 1954

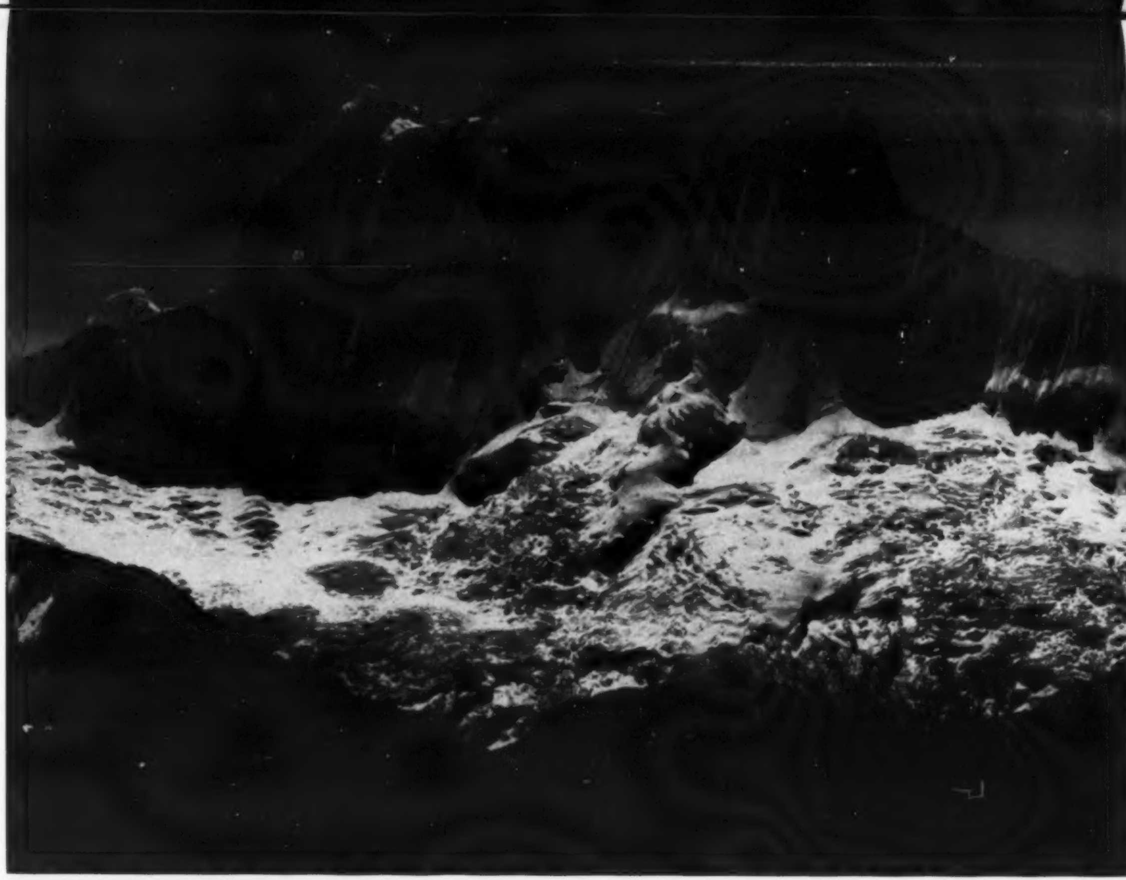
Eight photographs by Leigh Ortenburger

TELEPHOTO OF UNCLIMBED PYRAMID (unofficial name) 19,308

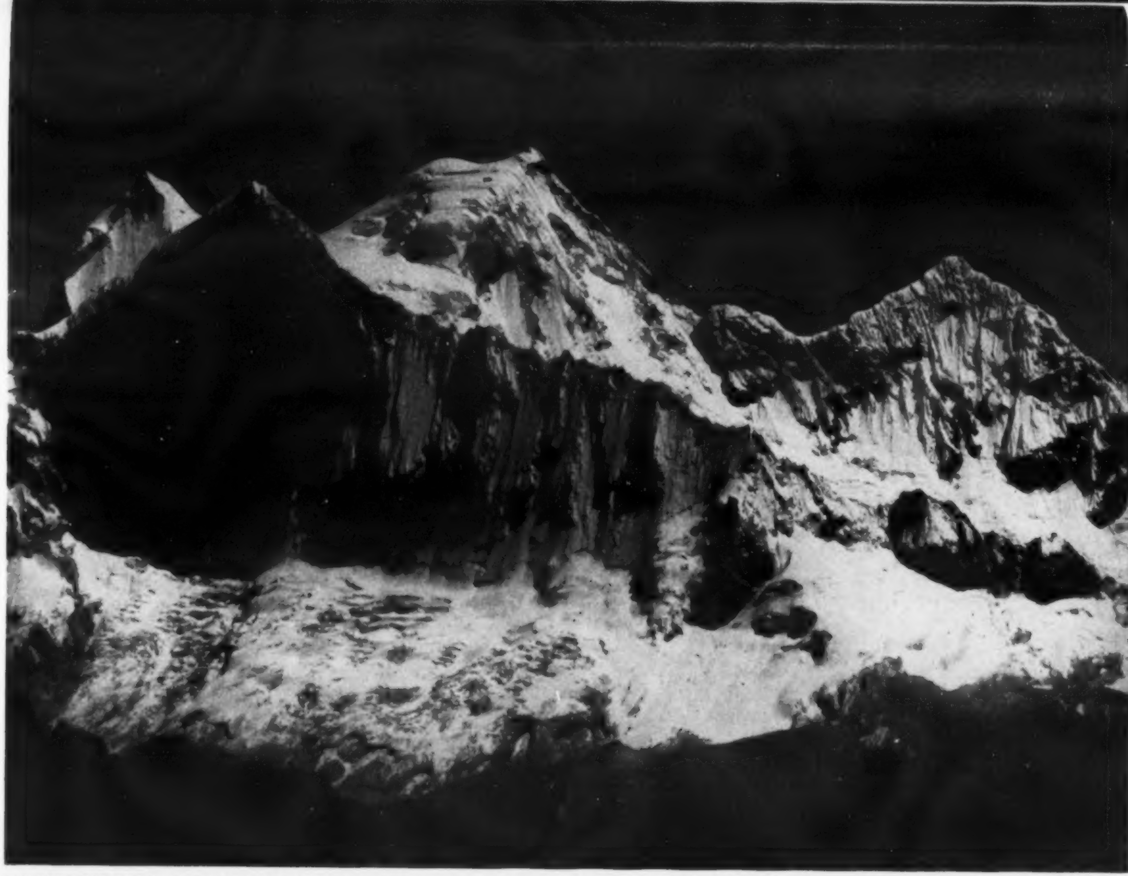


WEST PEAK OF HUANDOY FROM EAST (NOTE CLIMBER AT BERGSCHRUND)

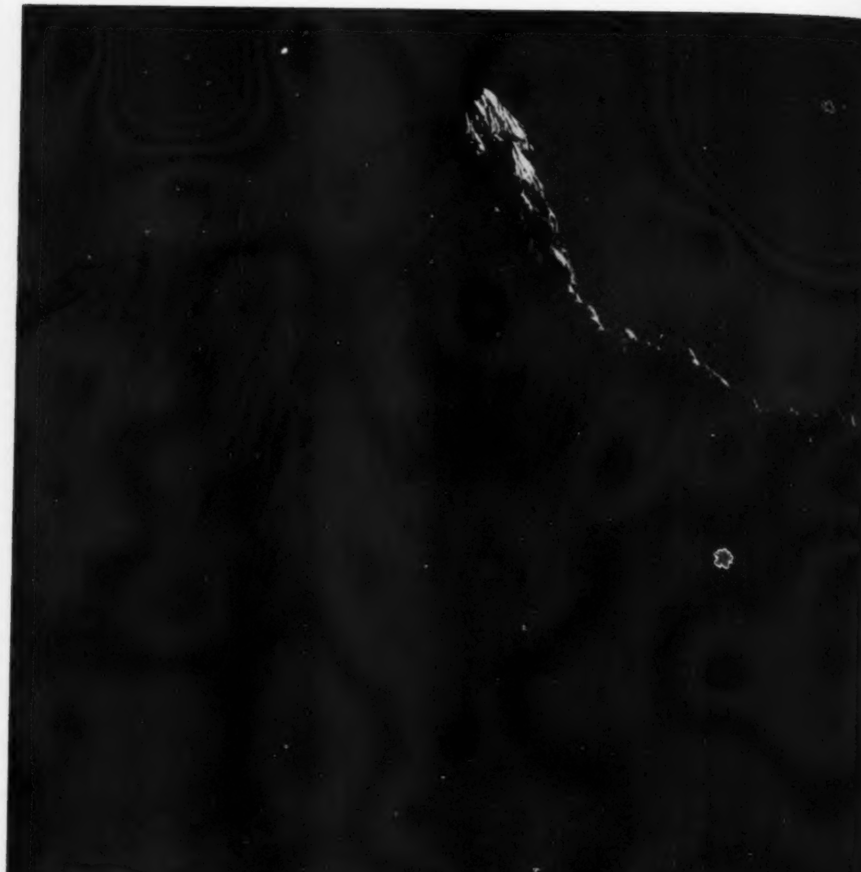




SOUTHWEST SIDE OF CHACRARAJU (20,000 approx.)



HUANDOY GROUP FROM SOUTH. L. TO R.: WEST PEAK, 20,853; SOUTH PEAK, 20,210; NORTH PEAK, 20,981;



TELEPHOTO OF EAST PEAK OF CHOPICALQUI (20,000 approx.)

Campfire at base camp on July 19 found everyone assembled once again, and opinions were heatedly exchanged. Chacraraju was declared to have avalanched off Matthews' proposed route from top to bottom even as the exploring group were viewing it; further, they said there was not the faintest hope for any route save the northeast corner. Even that would require a complete concentration of forces for two months or more, and this we were not prepared to do. Chacraraju was carefully crossed off the list of possibilities, and no one displayed any "extreme reluctance."

The report from the Huandoy party was somewhat more enthusiastic. They expressed the considered opinion that the western ridge of the south peak would "go." The trouble was, this would only lead to the south peak, and we did not feel that the plateau could be reached from the ridge. The final decision was to probe judiciously the southern side of the main eastern icefall in the hope of bypassing the icefall itself on the face of the south peak. At this time we were weakened by the departure of John Oberlin, who was called back to the United States.

Four judicious probers—Bell, Matthews, Michael, Ortenburger—and the four porters moved up on July 21 to reoccupy the advance base alongside the moraine of the Cook Glacier. Serac Camp at 18,000 feet, just under the ice cliff, was established the following day, as Ayres, Creswell, and Irvin, with the four porters, set up a relay support system. Two days of hard climbing carried the probers to the base of a 40-foot slab, which, they declared, would require direct aid. The altitude was 19,500 feet. The next day nine pairs of eyes watched closely as Matthews and Michael pushed the route over the slab and traversed to the glacier plateau—1,200 feet of fixed rope had been used between campsites. Falling rocks and icicles, together with loose gravel-covered rocks mixed with ice and snow, all set at an appallingly steep angle, gave us a feeling of apprehension, yet it was quite possibly the best available. That the route was somewhat dangerous became clear by Bell's statement as he returned to base camp the following day, saying that he had cold feet in more ways than one, and again by Michael's refusal to accept the opportunity to traverse the route once more.

On July 27, Ayres, Creswell, Irvin, Matthews, and Ortenburger carried loads up the fixed ropes to the plateau, with Ayres and Creswell returning to Serac Camp. The first ascent of the west peak, 20,850 feet—the highest unclimbed summit in Peru—was accomplished on the following day, July 28, by the climbers camped on the plateau. As the assault team prepared to ascend the north peak on the 29th, they were unexpectedly joined by Ayres, Creswell, and Michael, who had decided to spend a day in an all-

out effort to get to the summit. All six reached the top of the north peak, with three climbing all the way up and down over the long and difficult route from Serac Camp to the 21,000-foot crest. A brief attempt was made on the south peak during the morning of July 13, but the climbers who had now been on the plateau for three days and nights were feeling the effects of continual strong cold winds and lack of proper food and sleep. They returned to Serac Camp just at dark, expressing strong feelings of gratitude at their safe arrival. We allowed a day of rest, then completed the descent to base camp in one day, with the porters cleaning off the mountain and shuffling down under incredible burdens. A few more days and we had removed our base camp and ourselves to the town of Yungay.

Climbing had not ended, however, for above us beckoned the majestic peaks of Huascaran, the summit of all Peru. The north peak rises to 21,970 feet, and the south peak to 22,300. From the Santa Valley they are a truly indescribable sight, and it is no wonder that the native folk singers often chant the endless verses of a song entitled "Huascaran." To have reached the summit of Huascaran is to have achieved greatness in Peru; it seems indeed to be the only one of their many great peaks with which most Peruvians are familiar. Not surprising is it then that our ascent was complicated by the presence of two groups of Peruvian Alpinists following closely behind. One group at least was not so much seeking the summit, but fame.

We scraped out tent platforms for the Huascaran base camp on August 7. The following day all hands carried loads to the 18,000-foot level where Schrund Camp was established with Ayres and Michael installed as elected route finders. The evening of August 9 found seven climbers and four porters in Schrund Camp, with Ayres and Michael mystified as to the whereabouts of a route through the icefall above. That night was a hard one for at least one member of the expedition, as Irvin was stricken with a pulmonary infection and his violent coughing kept not only himself but everyone else awake. Irvin, with Ayres and Euhenio as physical and moral support, descended the 11,000 feet to Yungay the next day, where the low altitude and heavy doses of penicillin brought him speedy recovery. Meanwhile a route had been worked out bypassing the main section of the icefall on the south, and on August 11 a high camp was placed at 19,600 feet, just below the crest of the saddle between the north and south peaks. Bell was forced to retreat as the cold attacked old wounds of his frostbitten feet, and the now depleted ranks of the expedition prepared for the ascent of the south peak on August 12. Creswell, Eliseo,

Matthews, Michael, and Ortenburger breasted the snow dome summit of the south peak of Huascaran late in the afternoon, only to be forced off again almost immediately by winds of hurricane velocity. They returned to high camp shortly after dark. August 13—a Friday—saw the ascent of the north peak by a composite party consisting of Creswell, Ortenburger, Eliseo, Euhenio, and two Peruvian climbers whom they had previously rescued from a crevasse, Alberto Morales Arnao, and Alfredo del Arroyo. These were the third and fourth ascents of the south and north peaks respectively, ours being the first expedition to ascend both summits.

It was fitting and we were pleased that our porters Eliseo and Euhenio were able to make the final climbs of Huascaran as they did, for they were not only unexcelled as porters, but as climbers as well—with the true spirit of mountaineering which is lacking in so many Peruvian "Andinists." Only a few days remained before our departure from Peru. We shall all remember with a touch of nostalgia our last evening in Yungay—for as we ate an excellent dinner, and drank excellent wine, our ears were filled with excellent music played for us by our friends of the Santa Valley, while above us in the sky, hanging as aloof as the stars against the midnight blue, were the moonlight-silvered peaks of Huascaran—something that no one who has seen it can ever forget.

Do We Want Sugar Pine?

By HERBERT L. MASON

It has been suggested that any attempt to preserve the sugar pine in the condition in which it is now found is futile; that through natural processes the sugar pine is rapidly being replaced by incense cedar and white fir; that the sugar pine is therefore not a part of the ultimate stable forest community, but must give way to the dominant incense cedar and white fir. This argument is based on correct observations and sound reasoning.

But let us look at another set of facts. When civilized man came to California he found throughout the length of the Sierra Nevada a magnificent sugar-pine forest—the sugar pines mixed more or less abundantly with ponderosa pine, white fir, and incense cedar. This forest had all the appearances of a stable forest community. The evidence of reproduction was only of a replacement type with all characteristic species reproducing in this manner.

The relative stability of this early forest community seems to be fostered by two important facts. First, there was general over-all uniformity of the forest throughout the area. Second, white fir and incense cedar were not dominant over sugar pine, and the forest community displayed no evidence of having passed through an epoch of sugar-pine subclimax. Such a forest would have been characterized by either no sugar pine or only overmature sugar pine and fallen individuals; there would have been no evidence of any extended sugar-pine reproduction; the community would have had to be dominated by vigorous incense cedar and white fir in youth and early maturity so spaced as to control the area. No such forest was found upon the arrival of civilized man.

Now, however, such a forest, dominated by white fir and incense cedar, exists. This brings us to the anachronistic conclusion that both the forest as found by civilized man on the west slope of the Sierra Nevada and that which seems now to be replacing it satisfy the definition of a relatively stable forest community and the concept "climax forest" as employed by the ecologist. In these facts we have what on the surface seems to be a paradox—on the one hand, evidence that the sugar pine throughout much of its area is not a member of the stable climax community, on the other that the sugar pine was and, in some places at least, still is an integral

part of the stable climax community. Can this seeming contradiction be resolved in terms of phenomena that we can understand?

First let us consider the climax theory. It is a part of the logic employed in the interpretation of what we find in nature. We owe the climax theory to the late Frederick E Clements, who developed it to explain the end point in the natural sequence of plant succession. Clements conceived the progression toward the climax condition as being predominantly under control of environmental conditions classifiable as "climatic." He pointed out that the word "climax" as he employed it in ecology was not to be construed in the then current dictionary sense, but had the same etymological roots as the word "climate." He argued that all other conditions of the environment, whether edaphic or biotic, were themselves either the result of climate, or their influence was controlled by climate, or in the course of earth changes would at length disappear and the prevailing climate would then dominate the situation. He did not deny the influence of other factors, but to him none had the relative permanence of climate.

But it is now generally conceded that no single group of conditions is adequate to explain every community that displays the characteristics of a climax community. Some communities are dominated by one set of conditions, others by another, and the fortuitous nature of the course of the succession may influence what ultimately prevails. It is not enough to enumerate and measure the conditions of the environment, but something of their interaction and of their rhythmic and disharmonic fluctuation must be known, because the sequence of environmental events may alter the character of the stabilized end-point of vegetation. Furthermore, the local selective power of the environment will play a role in determining the success of the inhabitants of the area; will vary from place to place even within the range of conditions suitable to a given floristic complex.

What does all of this suggest for the sugar-pine paradox? It suggests that some environmental conditions have changed, because the practices of civilized man in his association with the sugar pine differ from the practice of aboriginal man. This difference tends to create conditions favoring incense cedar and white fir at the expense of sugar pine. One cannot, of course, exclude the possibility of variation in climate, but this variation hardly seems to have exceeded the range that was evident when civilized man first came; also its effect would be manifest as a gradient across the area of sugar pine, but the effects we note are evident throughout the sugar-pine range.

We may assume that the climatic potential for fire initiation through

lightning in the forest has been relatively constant throughout prehistorical and historical time; also that both aboriginal man and civilized man have been responsible for fire in the forest. The most important difference in man's relation to the forest has been that civilized man has built up a rather effective method of protecting the forest from all but the most devastating fires. In spite of many disastrous forest fires, the persons charged with fire protection are doing a very effective job against increasingly serious odds. Furthermore they have been responsible for one of the most amazingly successful educational jobs on record—of making the average man conscious of the danger of fire. In this set of facts we may have the key to the sugar-pine problem.

Fire protection has, on the one hand, apparently increased the selective potential of the environment for incense cedar and white fir and militated against sugar pine; and, on the other, created a condition which in turn increases the probability of devastating fires.

In semi-arid climates such as ours with summer thunderstorms, fire is a natural and characteristic feature of the environment. In addition, fire was set by aboriginal man.The natural vegetation in such areas becomes the product of a natural environmental relationship with fire. There is evidence that fire, whatever its cause, has occurred frequently enough in forests to have resulted in a relatively stable "fire type" vegetation. This was pointed out long ago by Jepson. In other words, certain types of vegetation cover are able to maintain themselves in the face of recurrent fire so long as the fire is not of too great intensity at any one time. Most low- and middle-altitude vegetation of California has this "fire type" character. The recurrence of minor fires prevents the building up of conditions conducive to disastrous high-intensity fires. Thus recurrent fire, regardless of cause, is and has been a part of the normal disharmonic fluctuation of environmental conditions.

Recurrent fire has played a role in the history of the sugar-pine forest, which is attested by readily observable facts. The trunks of many trees of different ages are scarred by fire around their bases and often to considerable height. The scars observed in any forest are of different ages, indicating several fires. The name "sugar pine" itself attests a fire history, because the most available source of sugar from which the tree derives its name is from the surface of burns where sugar sometimes exudes and crystallizes. These fires were ground fires of low intensity, which is attested by the basal position of the scars and the fact that the trees were not killed. That a "fire climax" was able to develop indicates that the fires recurred at irregular intervals depending first on a source of ignition and

secondly upon the accumulated undergrowth. The fires must have occurred often enough so that no hazard sufficient to promote disastrous crown fires developed, yet been of low enough intensity locally so that some of the young trees were able to survive to an age at which the thickness of their bark would protect them.

By our efficiency in fire protection we have removed a natural environmental condition that appears to be significant to the regeneration of the sugar pine. In its place is a hazardous climax not under the developmental regime of fire. Something of the nature of these changes can be gained from an incident in my experience. In the summer of 1923, in the company of the late Drs. H. M. Hall and F. E. Clements, I stopped a little above the present entrance to Yosemite National Park on the Big Oak Flat road to admire what Clements referred to as "a magnificent panorama of columns." Two years ago I took my wife and son to see this panorama and found that although the trees were still there, the panorama was gone. In its place, and obscuring it, was a thirty-years' growth of trees and brush. Some of the trees are no longer small. Here is a fire hazard to frighten anyone charged with the protection of this area every time a thunder storm passes over.

The situation presents a great dilemma. Nobody wants fire in our forests, however small its extent or however low its intensity. Yet everybody seems to want sugar pine. Well, what is the answer?

The answer is not entirely black, although it may leave some charcoal. Our desires, ideals, and prejudices are going to have to give way at some point in this problem, either on the precarious side of no fire or on the side of sugar pine. To have sugar pine means to have to accept some tampering with the sequence of the succession either by controlled fire or some means that will accomplish the same result. In the long run the cheapest method will be to maintain a forest in low-fire-hazard condition through controlled burning at intervals that will prevent the fire hazard from building up. This can be done in a manner that will protect sugar-pine regeneration; it certainly need not be done every year. If we choose to keep sugar pine, the situation has already reached such a state that we may have to do more than passive protection—we may have to remove and reduce fire hazard artificially if our enterprise is to have the only kind of fire insurance that will pay off in sugar pine.

I recommend that experimental areas be established on a sufficiently large scale to test such a plan and to determine the frequency and extent of burning necessary to perpetuate sugar pine and manage the forest in a continuing state of low-fire-hazard. Such experiments might be under-

taken in the national parks as well as in the national forests because a return to normal conditions is being advocated. At this late date, however, it might be necessary in some places to remove some young white fir and incense cedar by cutting to reduce the fire hazard during controlled burning.

Controlled burning is not new to the Forest Service. It has been employed extensively in the southeastern United States. It has been effectively employed by the Indian Service in the yellow-pine forests of Arizona. Members of the staff of the University of California have successfully employed it on an experimental basis for brush removal in range control and the reduction of fire hazard.

Our efforts to manage our forests without fire have not been entirely successful. Nature before us successfully managed the forest with her own system of controlled burning. As fire seems inevitable in our arid climate, would not the wisest course be to see that fire occurs only at such times and in such places as we choose? Under such circumstances the fire would no longer present a threat to our forests.

High Sierra Detail

FOUR PHOTOGRAPHS BY CEDRIC WRIGHT

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Of Timberline Trees and High Places

By CEDRIC WRIGHT

CONSIDER the life of trees—as understood by those who cultivate perception. Trees acquire from man the axe, the conflagration. What man may acquire from trees is immeasurable. For the forest is a resource of man's deepest needs: reverent silence, flowing poise, modest pride, self-sufficiency, beauty—even in death. What greater human needs? After openness to these words of the earth, finer values reside in the human spirit. Such is the harvest, the strange alchemy of the wilderness—for those to whom contemplation has become reverent experience.

In the solitary places, human life flows simply. Before a backdrop of silence, building campfires is like creating works of art. Whatever we do or think in the wondrous environment of the forest sings with fresh fluency. Within humble simplicities, the joy of living expands, because one becomes aware of the roots of being, and at last moves in harmony with them. A strange inner philosophy takes over. It descends from tree branches—drifts from earth and sky.

Some deep reality appears—a vast healing. It is a healing of the outraged inner self—the self long bludgeoned by opinions of the high and mighty, newspapers, radio impositions, and all the bedlam of an over-populated earthful of people. This roaring composite of confusion is silenced for a while. One gains traction on life.

In contrast to man's world, the forest does not scream for attention. Here is a world whose deeper understanding remains tantalizingly beyond human comprehension. Yet the sensitive, during occasional flashes of intuition, see a glimmer of the consciousness which resides within these mute forms. Thereafter, it may be doubted that man is the highest form of life, as he has chosen to believe. Man is more likely to believe, after knowing the spirit of the wilderness, that he is in need of readjustment. The outlines of that readjustment clarify under wilderness moods.

In moments of inner seeing, one may realize those other than material roots which nourish the psychic life of the forest—the roots of its beauty, the roots of its unknown consciousness. Through such psychic roots the forest reaches communion with the world spirit. Here is the essence of true religion.

I lie by a Sierra stream. Submerged tree stems, mossed granite, sway-

ing willow and alder, infinite water patterns, glint of light—all under the free playfulness of subtle rules of nature. From this mysterious composite there arise influences toward man's renewal. In communion with these surroundings, worries fade before a sun-baked optimism.

In all its speaking, nature never proselytes. Nature blesses through her songlike world of beauty. As the astronomer predicts the appearance of a new star which has never been seen, so, in trees one sometimes feels the presence of some unknown consciousness.

If only more people everywhere might be exposed to these life values of the wilderness that they might acquire the sweetness and the dignity of this nonhuman world! With awareness of the wilderness, humanity could be brought to peace. For the pathway could open toward tolerance and compassion. The chain reaction, the sequence of cause and effect, here assure such destination. While the wilderness within itself may be a vast battle for survival, it has no such influence on man. For man it induces the blessings inherent in beauty and in meditation.

There is a vital importance in bringing the pathways of the spirit into the concern of popular education. If not directly from or through nature, then through the kind of art and thought which carry similar moods. Here lie directions of rescue for a tottering human world.

A Rope Length From Eternity

By WILLIAM SIRI

An expression of surprise and pain flashed over the climber's face as he was wrenched from his belay position by the heavy shock from the climbing rope. No longer restrained, the rope whipped around his body, ran free, and dropped out of sight.

"Why did you let go of the rope?" I asked.

"Well, look at me. I couldn't hold a sack of feathers after I was dumped," protested the belayer, "and besides, the pain was killing me!"

Fortunately it was not necessary to point out how the falling climber—the man he was belaying—was going to feel about the "killing" pain in a moment. This time the only result of the belayer's failure was a heap of bodies untangling itself on the turf just below him—and a reading on the dynamometer inserted in the climbing rope.

This kind of tug-of-war has taken place many times during the past few years and always the belayer has been the "fall guy," vainly trying to withstand the concerted jolt from six men or a sack of falling lead on the other end of the rope. But this produced the information, or at least part of it, that we wanted. How much tension can a belayer hold? Why did the belay yield? What are the best belay techniques? Is there anything new to be learned about climbing techniques? And, of course, the occasional query, why bother with this when all you need is experience?

The answer to the last question is obvious. There was a time when the most experienced mountaineers in the world used rock belays, a practice which too often cost them their best friends. Even today some experienced climbers employ the discredited shoulder belay. Answers to the other questions and, indeed, to the whole problem of climbing mechanics are less obvious and not likely to be found quickly in the casual experience of the week-end climber.

The motivation in answering any of these questions is, of course, safety in climbing—to give the climber an even break with the irreducible hazards of the sport and, more particularly, with himself for occasional and sometimes fatal blunders. The tests described here were not intended to eliminate the hazards in mountaineering—at best they can only be minimized—but rather to investigate the mechanics of some techniques now in use. More particularly they were directed toward measurements of

forces on belayers, rappels, and anchors, and frictional forces under actual and simulated climbing conditions. While some of the details may elicit only academic interest, the results generally should permit the selection of certain techniques and the rejection of others on grounds more reliable than intuition. Besides, it is helpful to know the inherent limits of the techniques we practice.

ONLY THE G'S COUNT

The principles and practice of the dynamic belay were fully and carefully formulated in the classic article by Richard Leonard[1] and Arnold Wexler, while somewhat later Wexler[2] laid out the mechanics of the dynamic belay in the objective light of mathematical analysis. In these articles it was clearly demonstrated that only in absorbing energy gradually, by allowing the rope to run against frictional forces, could a fall be arrested with certainty. Rope may sometimes possess the strength but never the resiliency to do this job alone, as in the static or rock belay, without seriously endangering the falling leader and his belayer.

A brief review of the energetics of falling will give us a working conception of dynamic factors involved. Work or energy is defined as the distance traveled by an object times the force boosting it along. In a free fall the force is gravity and the kinetic energy developed is simply the distance of the fall times the weight. A 150-pound man falling 20 feet develops enough energy to operate a 60-watt bulb for one minute or to heat a quart of water about two degrees. This is less academic than it appears, for this same amount of energy must be absorbed in arresting the fall, and nearly all of it appears as heat because it is absorbed almost wholly by frictional forces. The quantity of heat produced is of little consequence because it is spread throughout a pound or so of rope, some rock, and the belayer, and it is the same whether the fall is stopped quickly or slowly even though friction-point temperatures may vary. For a different reason, however, the rate of absorption of energy, that is, the speed of arrest, is the most important factor in belaying. It determines the restraining tension in the rope and consequently the forces on pitons and belayer as well; obviously the faster the stop the greater the tension. If a 150-pound leader falls 20 feet free and is then stopped in another 20 feet at a uniform rate, the rope must exert a restraining force sufficient to decelerate him at the same rate he initially accelerated (1 gravity or 1 g) plus the man's weight, a total of 300 pounds. If the climber is brought to rest in 2 feet, the deceleration is then 10 g and the tension $(10 + 1) \times 150 = 1650$ pounds. It may be argued that nylon rope will safely handle this

load, but the real question is: Will the falling leader, the belayer, or the piton yield?

IT'S NOT THE FALL . . .

. . . It's the sudden stop that hurts. The maximum deceleration, or if you prefer, shock or impact, a man can take without mortal injury is not known except in a few special circumstances. It depends not only on how it is applied but also on the duration and rate of onset.

Analysis of accidents reveals a few extraordinary instances of collisions and falls in which victims survived decelerations in excess of 100 g; for our 150-pound man this is 7.5 tons.[3] Survival was possible only because by freakish luck the force was distributed uniformly over the body. Even so, internal injuries were suffered in such falls.

Colonel John P. Stapp of the Air Force, riding a special rocket-driven sled, has repeatedly withstood decelerations of about 50 g in the course of his studies on the effects of high deceleration on man. But when riding his sled, Col. Stapp is seated in a steel chair and securely strapped to distribute the load over his body, and he wears an anchored vest harness to prevent his evisceration.

No one knows with certainty what deceleration man can sustain without serious injury when supported only with a waist loop of rope. The author, who weighs 155 pounds, has sustained decelerations of about 9 g in test falls[4] with a rope waist loop, but he was careful to remain upright. The most intelligent guess places the limit at about 10 g for the usual lean mountaineer. This probably is still too great for unfavorable positions of the body at the time of impact, for example, prone or supine, and perhaps too low for the most favorable, that is, upright. If any orientation of the body is likely in midair, the chance of being erect at the crucial time is rather small, so let us set at 6 g the maximum deceleration to which a man is ever to be subjected. Needless to say, the strength of $\frac{7}{16}$-inch nylon climbing rope far exceeds the tension which can irreparably damage a falling climber. This is not, however, an argument for using lighter ropes. We estimated only the force a man could take; there are additional factors to contend with for the rope.

One may argue the relative importance of leader and belayer during the climb, but the instant a leader begins a quick descent, the belayer's position is indisputable. He is sole master of the affair for an interval of 3.5 seconds (the time to fall two rope lengths, or 200 feet). For this brief but crucial time his single function is that of an animated friction brake. It is his job to absorb the leader's ill-gotten kinetic energy at a rate which

on the one hand will not strain to the breaking point the leader, the rope, pitons, and himself, and on the other hand will arrest the fall as quickly as possible to minimize the leader's wear and tear on rocks en route. This undeniably is a sound principle but the practical questions still remain: What is the best way a human can simulate a friction brake, and how much force can the brake apply? It was here that tests with a dynamometer began to show useful results.

HOW, WHY AND WHERE

Belay stances, despite seemingly endless variations—and a few unbelievable ones—fall naturally into four classes: sitting hip belay, standing hip belay, standing seat belay, and shoulder belay. Each has several variations, some of which are shown in the illustration. These depend mainly on the angle of the rope and the use of foot support.

Each of the belay stances, and its variations, was tested for the maximum tension that could be held, or the load which caused failure. The reasons for failure or yielding were noted and each position was tested dozens of times with belayers of both sexes, a wide range in weight and experience, and at six different climbing sites in the San Francisco Bay area. Some tests were made with a 100-pound lead weight simulating a falling body, but for most the tension was supplied by the enthusiastic effort of four to six men on the other end of the rope.

The force on the belayer was measured with a Dillon dynamometer, a device for indicating tensions up to 2,500 pounds. This invaluable instrument was lent to the Sierra Club by W. C. Dillon and Company of Los Angeles and played a key role in our measurements. For the belay tests the instrument was inserted in the rope immediately in front of the belayer before the rope passed over rock or through a carabiner where friction greatly altered the tension. In this way the true force on the belayer was measured. After each test, the peak force recorded on the dynamometer was the maximum force or rope tension the belayer held before yielding.

Belay failure meant collapse beyond the point where the belayer could effectively control the rope. In extreme cases, the belayer was wrenched bodily from his location and only the anchor rope prevented early reunion with his ancestors. More often, failure resulted from collapse of the legs or back and from being twisted out of position by the high torsional moment—a factor about which more will be said later.

It should be emphasized at this point that we are interested in maximum tension a belayer can successfully manage, and that belay failure, while the most serious, is not the only limitation. Collapse most frequent-

ly set the yield point but did not always progress to failure. In the most secure belay positions when collapse did not occur, rope slippage and pain placed an upper limit on the tension he could hold. In either instance the belayer still possessed full control of the rope and continued to function as a friction brake although holding a somewhat lower tension. For any one, or combination, of these factors—failure, collapse, rope slippage, and pain—the belayer was always tested to the yield point.

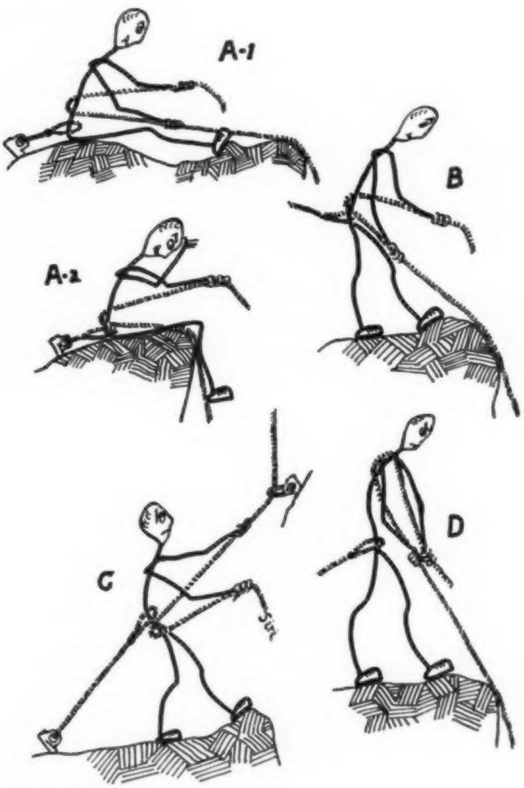


Figure 1. PRINCIPAL BELAY POSITIONS. Direction of rope shown after a fall. *A-1* and *A-2*, sitting hip belay; *B*, standing hip belay; *C*, standing seat (sling shot) belay; *D*, standing shoulder belay.

SITTING CAN BE A VIRTUE

The sitting hip belay with good foot support (figure A-1) is by all odds the most secure and effective as well as the most comfortable position of any tested. Sixty-five tests were made with 20 persons. The yield point ranged from 200 to 560 pounds tension and the average for the lot was 340 pounds. In three-fourths of the tests, the belayer ultimately collapsed and in the others the rope slipped although still under high tension. The highest loads were held only in positions with firm foot support, with the legs straight and the rope running parallel to and between the legs. If the knees were bent or the rope ran high over the foot support, the belayer collapsed or was simply extracted from his position by 200 to 300 pounds tension although still maintaining some control.

The sitting belay with no foot support or with the knees bent more than 20 or 30 degrees is considerably less reliable unless the belayer is securely anchored.

In two situations, however, the sitting belay without foot support is one of the strongest positions tested. If the belayer is seated behind a ledge or knob of rock, perhaps only 6 to 10 inches high, it is nearly impossible to unseat him. It also gives him the advantage of more rock friction, which we shall see is one of the important factors in belaying.

The second position (figure A-2) is the ledge seat with feet dangling over the side. The strength of this position was unsuspected until a dozen or more tests revealed that it is nearly impossible to dislodge the belayer before he first yields at 300 to 500 pounds tension from pain or rope slippage. It was then recalled that some of the longest accidental rock-climbing falls, up to 100 feet, have been held with this seemingly precarious belay. It has, however, an important qualification. The rope should pass around the hips as low as possible and it must pass over the thigh and directly down between the legs and over the rock ledge. Fortunately, if the belayer sits on a ledge, this should happen naturally. It may be noted too that a seat on the lip of the ledge with no foot support is often preferable to a sitting belay farther back if it offers only minimal foot support. The strength of this position seems dependent upon the effect, unique here, that the greater the rope tension, the greater the force on the seat of the pants, and hence the greater the resistance to dislodgment.

Thus far, the results may suggest more of an indictment than a recommendation of the sitting hip belay. The average yield point of only 340 pounds would seem entirely inadequate, but we shall see that it is a far greater average tension than can be held in any other position. Also we have not yet considered the beneficial effect of rock and carabiner fric-

tion. The single most important property of the seated belay, and the characteristic which sets it apart from the standing belays, is this: after the yield point is reached, the anchored belayer, even if collapsed, retains control of the rope and can still arrest the fall more effectively than is possible in other belays. In brief, utter failure with loss of rope control is unlikely in the seated hip belay.

STANDING ROOM ONLY

The next-best thing to a sitting hip belay is the standing hip belay (figure B) but, judging from the results of these tests, the gap between them measured in reliability is large. There are times and places where there is no other choice, as in belaying from a six-inch ledge or while hung in sling ropes, but still we should respect the inherent weakness of the stance. In twenty-three tests the yield tensions ranged from 135 to 375 pounds, with an average of about 225 pounds. But in all these tests there was ample space to place one leg forward along which the rope ran. With both feet together, the belayer was pulled off with less than 100 pounds tension unless the rope ran straight down over a ledge, or he was anchored under tension.

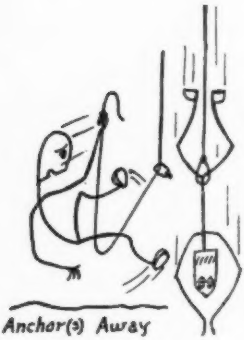
In nearly every test, the belay failed; the belayer's legs collapsed or else he was wrenched from his position—and then collapsed. The end result generally was an irretrievably lost rope, which in actual practice would, of course, have a climber on the lower end. Still, on occasion, this belay must be used. The results here strongly suggest, however, when belaying the leader the belayer should always securely anchor himself with a taut rope, preferably to a point at least waist-high and as close as possible to his waist loop.

THE SLINGSHOT

One of the two poorest acts in the belayer's repertoire is the standing seat belay (figure C), a standing position with the climbing rope passing around the seat of the pants and upward through a carabiner. Anyone observing belay practice will recall with amusement the involuntary acrobatics performed while holding practice falls with this belay. It can best be described as the "slingshot" belay. Without a properly placed anchor the belayer usually cannot hold 100 pounds tension, and even with an anchor he can sometimes be spun like a top or flipped heels over head by the impact of only 150 pounds tension.

Nevertheless, this stance is perhaps the belay most frequently used on difficult climbs, and, let us admit it, often the only belay possible on

fifth- or sixth-class pitches. Fortunately it cannot be used without a piton somewhere above the belayer, and it is this bit of hardware which makes the slingshot belay practical, though still suspect. In arresting a fall the carabiner absorbs a substantial part of the energy, which in turn reduces the impact on the belayer. After the rope has passed through two or more carabiners and over rock surfaces, the belay becomes quite secure, but then any belay would. If only one carabiner is used, it had better be attached to a sound piton; it will have to bear far more force than the belayer.



Anchor(s) Away

A properly placed and taut anchor is fully as important as the upper carabiner, for it should be remembered that a trip through a carabiner will benefit neither falling climber nor belayer. The obvious mechanics, as well as our tests, suggest that the anchor rope should follow the same angle as and preferably a steeper angle than that of the climbing rope. The anchor here cannot be regarded simply as a safety measure; it must be in a position to give direct aid to the belayer in arresting a fall. Much of the tension will be transferred through the belayer's body to the anchor instead of to the seat of the pants and the legs as in the sitting belays.

It goes without saying that the end of the rope to the leader should pass around the belayer on the side adjacent to the wall. The torsional moment will then pull him against the rock to give additional support, rather than off into space.

SHUN SHAKY SHOULDERS

The standing shoulder belay (figure D) was tested and found wanting because of a very crucial weakness. Surprisingly enough, in 45 tests a dozen different belayers held tensions ranging from 200 to 360 pounds, a reasonable yield point in view of what other belays held. Its real weakness lay in the fact that every belay yielded in total failure. Either the legs or the back buckled, and the belayer was driven to the ground with complete loss of rope control and often of himself. An anchor was of little direct aid; it simply prevented the belayer from going completely over the side. The argument for the virtues of "give" from leg flexion in the standing belay is unfounded since the energy that can be absorbed in this manner is an inconsequential fraction of the total. Bent knees in any standing

belay, moreover, are a guarantee of early collapse. Fortunately the shoulder belay does not lend itself to belaying the leader. Even so, it is difficult to see where this belay is justified under any circumstances other than premeditated homicide.

FRICTION BETWEEN FRIENDS . . .

Two questions still remain to be answered: how does the human brake operate most effectively, and how can a belayer arrest a fall calling for a tension several times greater than he can hold?

To answer the first of these, picture the body as a snubbing post which, of course, is precisely what the belayer forms. The law for snubbing posts says that the load L which can be held by a tension t at the free end of the rope increases very rapidly with the angle around the post. More exactly, the engineer expresses it as $L = t\,e^{\alpha\theta}$, where α is a constant depending on the friction, and θ is the angle. It was not surprising to find that belayers approximate this same law when tested with climbing rope, known loads, and sets of scales. Both nylon and hemp ropes were tested on belayers large and small, wearing cotton, wool, and leather jackets, and at angles of 90, 180, and 270 degrees around the body.

Under all conditions mentioned above the coefficient of friction, α, for dry nylon rope varied from 0.55 to 0.72 per radian with an average of 0.62. The kind of clothing worn made little difference and the size of the waistline has no influence; a neat 25 is as effective as a beer-laden 50 inches. Hemp and wet nylon have higher coefficients but data are insufficient to suggest reliable values.

There is no need to search for a table of natural logarithms to see what this means; it can be translated very simply in this way: for every 60 degrees of the rope around the waist, the tension which can be held by hand *doubles*. A restraining force of 20 pounds will hold a tension of 40 pounds at 60 degrees, it will hold 80 pounds at 120 degrees, 160 at 180 degrees, and 320 pounds at 240 degrees. Thus with the rope less than three-quarters of the way around the body, a grip of only 20 pounds will hold nearly the average yield tension for the sitting belay. The soundness of current belay practice is evident; to arrest a fall it is only necessary to increase the angle beyond the normal 180 degree position in order to develop a very great restraining tension at the cost of very little effort. To accomplish this, however, the belayer must increase the angle by wrapping the rope farther around his body *before* he grips the rope more tightly. Doing it the other way he will find his hand useless at his waist or behind him.

The same principles apply to rock and carabiner friction though it is less easy to express the results in algebraic terms. A belayer never experiences the same tension felt by the falling climber; much of the energy, and with it the tension, is absorbed by intervening sources of friction. A belayer applying a tension of only 100 pounds may have arrested a fall where the effective tension at the other end was 500 pounds.

. . . AND AROUND CARABINERS

Carabiner friction is evident to anyone who has led fifth- and sixth-class climbs. In measuring this effect with nylon rope we found the tension was reduced by one-third when the rope made an angle of only 45 degrees. At 90 degrees it was reduced by one-half, and at 180 degrees by nearly two-thirds. The friction appeared to be slightly greater for wet nylon and, wet or dry, it seemed slightly higher for $\frac{7}{16}$-inch aluminum carabiners than for $\frac{3}{8}$-inch steel varieties. In a lengthy series of tests, no significant difference between "static" and "running" friction was found. For practical purposes the change in tension in a rope passing through a carabiner is the same whether it is sliding or stationary.

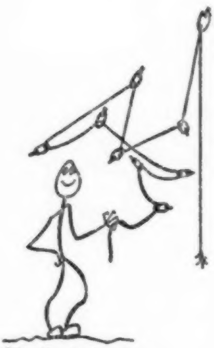
The measurements of carabiner friction showed considerable uniformity but those on rock varied widely with the kind of rock surface, radius of the edge, and so on. The only generalization which seems justifiable, other than the obvious one that rock friction is large, is an order of magnitude of the effect. If the rope made an angle of 45 degrees over a rock ledge or surface, tension was reduced by one-quarter to one-half. For a 90-degree turn, tension was diminished by one-half to two-thirds. It was also observed that the static friction was about the same as running friction.

It now becomes evident why a belayer can stop a long fall calling for more tension than he alone could hope to muster. The rope invariably passes over a rock ledge and knobs, and at each such point a substantial fraction of the tension is canceled. If pitons are placed, the rope obviously will turn an angle of about 180 degrees through the highest carabiner when a fall occurs and this alone will reduce tension by two-thirds.

All this adds to the belayer's security. Suppose a 150-pound man falls 50 feet free and is stopped in another 10 feet. The rope tension at the man is $(50/10 + 1) \times 150 = 900$ pounds, but what is the tension at the belayer? If the rope runs over a ledge, making an angle of 45 degrees, the belayer holds only about $\frac{1}{3} \times 900$, or 300 pounds. If the rope turns 45 degrees over a second rock point, he holds only $\frac{1}{3} \times \frac{1}{3} \times 900$, or 100 pounds. Similarly, if the rope runs through a carabiner, without touching

rock, the restraining tension is $\frac{1}{3} \times 900$, or 300 pounds. Note, however, that the force on the piton is $900 + 300 = 1200$ pounds or 4 times the force on the belayer.

We are led inexorably to the preposterous but very real situation in which the rope passes through 10 carabiners and over several rock surfaces and we find the belayer frantically feeding rope through the carabiners in order to effect a dynamic belay. The friction has become so great that the mere weight of the rope will hold more than 900 pounds tension. This difficulty is often encountered on long sixth-class pitches and is potentially dangerous. In effect, the leader is guarded by a static belay, and if he falls he can depend only on the rope's elasticity and pray the tension will not exceed the strength of himself, the rope, or the highest pitons. To avoid this, he has, before proceeding, no alternative but to disengage the rope from lower carabiners where it turns an appreciable angle and to reroute the rope so it will engage less rock friction.



"Hardly Felt it..."

YOU CAN GO ONLY SO FAR—UP OR DOWN

Returning to belaying in general, it may now be apparent that skill in belaying lies in judging the circumstances from moment to moment as the leader ascends, and in applying a tension should a fall occur, which will safeguard pitons, rope, and leader. Experience is the best judge but a few guiding points may be noted. A lead without piton protection (4th-class pitch) is the most demanding for the belayer. He can usually count on assistance with moderate rock friction but still may need to—and indeed should always—apply the greatest possible restraining tension compatible with the security of his belay position. This partly contradicts current theory in teaching and practicing belaying but the rationale is straightforward: without carabiners it is unlikely that a belayer can ever apply tension great enough to seriously injure the leader and, less still, to break the rope—unless he is using a rock (static) belay. Since there is an inherent safe limit in the tension a belayer can hold, nothing is gained by stopping a fall too gradually except a greater likelihood of badly injuring the leader on rock, or worse, by his hitting "bottom."

The leader has a responsibility, too. Wexler, in the article mentioned earlier, has clearly shown the folly in advancing so far that the belayer is

left with too little rope to arrest a fall dynamically. If the belayer, aided by rock friction can reasonably expect to hold 600 pounds tension, the leader should not advance farther beyond the belayer than a distance[5]

$$x = L\left(\frac{600 - W}{600 + W}\right)$$

where W is the leader's weight and L the effective rope length (about 110 feet for a 120-foot rope). The "safe" advance for a 150-pound leader, for example, is about 65 feet.

If pitons are used, the belayer must exercise more caution in applying tension because of its great multiplication by carabiners and rock. It is here that fine judgment is needed, for an overzealous belayer endangers rope, pitons, and leader. This point cannot be too strongly emphasized because the amount of restraining tension needed to arrest a fall "safely" depends upon the immediate circumstances and, more explicitly, upon the rope friction between belayer and leader. It varies in continuous gradation from the maximum which the belay position permits (fourth class lead, therefore no pitons used) to almost nothing when the rope passes numerous carabiners and rock edges. Again the responsibility is in part the leader's: how far can he go beyond his last piton? Again we can give a rough rule, but now the advance is limited by what the falling leader can take and not by the restraining tension the belayer can apply. Let us assume the leader is not to be subjected to more than 6 g deceleration (1,050 pounds for a 150-pound man). Then if the rope length from belayer to the highest piton is H feet, the leader should not advance more than $x = \frac{3}{4}\ (L–H)$ feet beyond his last piton before placing another, or reaching safe ground.[6] In other words, do not go beyond the last piton a distance more than three-fourths of the length of rope the belayer still has on hand. This is the distance for which the belayer will have just enough rope to arrest a fall at the rate of 6 g. If a fall occurs at this maximum unprotected advance, the last piton must hold a force equal to $(\frac{2}{3} + \frac{1}{3}) \times (6 + 1) \times$ weight—1050 pounds for a 150-pound leader.

MISCELLANEOUS IMPORTANT DETAILS

A final detail, common to all belays, deserves brief mention. It is the angular impulse of the rope tension on the belayer's body. The rope, passing as it does around the body, impresses a turning moment about the backbone exactly as it would on a top. The effect can be judged by an example: a belayer with a 6-inch radius waist holding 300 pounds tension experiences a moment (twisting force) of $300 \times \frac{1}{2} = 140$ foot-pounds, about the same as 70 pounds held at arm's length. With present

techniques the belayer has no choice but to adjust his stance to resist this effect with legs, seat, and backbone, while simultaneously holding the direct force of the rope tension. This effect deserves the highest respect since it always contributed to and often precipitated collapse in our tests. An anchor rope does not help resist the twist. A possible solution, not yet tested, would require wrapping the anchor rope twice about the body in a direction opposite the climbing rope and then making it taut. This could be helpful in the seat (slingshot) belay where twisting is most serious and where a tight anchor rope would be tolerated better since it is then around the hips instead of the more vulnerable waist.

Several belay problems still remain unresolved. What has been said above for belays on rock applies in principle for snow and ice climbing. The belayer is in a far less secure position and generally cannot count on much aid from frictional forces. There is but little uniformity in the techniques practiced, and many belays the writer has observed could only have given psychological security. Thus far the combined ice-axe–body belay[7] seems one of the most reliable, *if* the axe is held in with a foot.

Even more troublesome is the frequent need, in snow climbing, for all men on a rope to move together. It means setting an improvised belay while a fall is in progress, which, in deep soft snow and on ice, is nearly impossible. At best success is uncertain, though experts have performed outstanding feats. Further development of ice techniques is needed, together with tests by methods more substantial than intuition.

In the writer's opinion, the do's and don'ts of belaying, at least on rock, can best be summarized as follows: don't stand when you can sit; do use an anchor when belaying the leader; do use rock and carabiner friction but don't overdo it; don't advance more than 70 feet on a difficult pitch without hardware; don't advance more than ¾ $(L—H)$ feet beyond the last piton; and do, please, arrest the fall.

Turning from uncontrolled to controlled descents, the stresses in rappel systems were an easy mark for the dynamometer. Tensions on rappel anchors and in the rope were measured under a variety of conditions and the results generally were heartening. On vertical and overhanging cliffs where stresses are greatest, the rope tension rarely exceeded one-third more than the body weight. While a man is sliding, the tension may be less than his weight—otherwise he would not start. Long, smooth leaps and steady descent produce the least tension, usually not more than 25 to 50 pounds in excess of body weight, and then only on slowing down or stopping. Short, jerky jumps cause higher tension but still less than 75 pounds over body weight. The highest tension recorded in these tests, 550 pounds, was

achieved intentionally by a 150-pound man who dropped 50 feet with the least possible friction and then stopped himself in midair with a maximum effort. This is only of academic interest, however, because tensions of this magnitude are probably never encountered in normal rappels.

The force on a rappel anchor depends somewhat on the intervening rock over which the rope passes, but in general the force is of the same order of magnitude as the tension in the free rope because the anchor is usually placed at a point where the rope is least obstructed. Where the rope passes over a ledge, only two-thirds of the rope tension may be felt by the anchor.

Tests on pitons for failure in rock appeared to have rather limited value. They merely demonstrate what we already know, that at the one extreme they will sometimes not hold a man's weight, and at the other, they can easily support more than a ton. This is an area in which proper training and experience in placing pitons supersedes tests with dynamometers. On the other hand it is essential for the piton itself to possess no inherent weaknesses in design and material. This, however, is more a problem in establishing minimum specifications for their manufacture and in testing designs and metals with laboratory testing machines.

During the course of our survey of belay techniques, a few innovations were also examined. Among these was a new kind of safety belt manufactured by the Rose Manufacturing Company of Denver. Samples of the belt, together with a portable winch, were provided by Mr. Clarence Rose for testing. The belt's principal feature is a built-in length of undrawn nylon which elongates under constant tension, for example, 600, 1200, or 1500 pounds, and hence absorbs energy inelastically in stretching permanently as much as three to four times its normal length. The belt is well-suited for construction workers who use a static belay but probably would add little to the security of the dynamic belay as it is now practiced in climbing. However, the real deterrents to general acceptance of the belt probably would be its relative bulkiness and cost.

Another item has been tested with complete satisfaction on rock climbs. It is a plastic or fiber helmet, similar to but lighter than those used by construction workers. There is, perhaps, no other activity in which head protection is more justified than in rock climbing and yet it seems wholly disregarded. A blow, either on or by rock, which would cause no more than a bruise on any other part of the body can produce serious head injury. It is also a nuisance for the rest of the party for it usually terminates the climb. The writer, after looking over casualty reports, can only conclude it is time to give yourself instead of your head a break.

ACKNOWLEDGMENTS

The author is indebted to David R. Brower and Richard M. Leonard for many valuable suggestions and for instructive debate on certain issues discussed above. The tests reported here are only an extension of their more fundamental contributions to modern climbing practice. The author gratefully acknowledges also the suggestions and corrections given by Charles Wilts and Arnold Wexler. Professor Wilts, using a different experimental technique, found carabiner friction somewhat lower than that reported here. The difference has not yet been resolved.

A careful guard was maintained against the intrusion of mathematical formulations but despite this, three formulas leaked into the text. The friction formula is found in elementary engineering texts. The other two, defining the maximum "safe" advance, are derived as follows: the rope length from belayer to the farthest piton is H feet, the leader advances x feet beyond and falls $2x$ feet. The length of rope required to decelerate him at g gravities is then $2x/g$. If x is to be a maximum, then the sum of these segments equals the rope length or $L = H + x + 2x/g$. Setting the limit on g at 6, then

$$x = \tfrac{3}{4}\,(L - H)$$

For the other formula, $H = 0$ (no pitons), and force $= 600$ pounds $= (g + 1) \times$ Weight. Substituting for g, the "safe" advance beyond the belayer, in terms of maximum tension is then

$$x = L\left(\frac{600 - W}{600 + W}\right).$$

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See also Brower, David R., ed., *Manual of Ski Mountaineering* (University of California Press, 1946), p. 167.

[3] See, for example, DeHaven, Hugh, "Mechanical Analysis of Survival in Falls from Heights of 50 to 150 feet," *War Medicine,* II (July, 1942), p. 586; Life (Jan. 19, 1953), p. 28; and occasionally your local newspaper.

[4] The force measured with a dynamometer.

[5] See preceding section.

[6] See last section.

[7] Beckey, F., "Belaying: Belaying on Snow and Ice," *American Alpine Journal,* VIII:1 (1951), p. 97.

California Avalanche

By KENNETH D. ADAM

To most of us, even if we like to venture into the high country away from the mechanized ski slopes, avalanches are impersonal phenomena to be admired from a distance or to be read about. Occasionally we hear of skiers lost in snow slides at Alta, Aspen, or Sun Valley, and our reaction is: "Aren't we lucky to have the Sierra for skiing where we can keep away from such hazards?" We say: "In our range we can tell what will and what won't slide and can stay out of danger. No one ever hears of skiers getting caught in avalanches in the Sierra." This last sentence almost came into the category of famous last words on a slope above Echo Lake on New Year's Day, 1955, when four very lucky skiers were dug out of an avalanche feeling much more experienced than they had an hour before and with an urge to preach the dangers of snow slides to any other skiers who would listen. A remark about skiers never getting caught in the Sierra had indeed been made by one of the four shortly before he was buried.

On New Year's Eve our party at the cabin on the peninsula between Upper and Lower Echo lakes was still drying out after a very wet trip in from U.S. 50. We had made the three-mile trip from the highway in either a light drizzle or very wet snowstorm the whole way. The weather had turned warm that morning after the fall of dry powder two days before. After skiing across Lower Echo Lake our clothes were so wet that we spent the entire afternoon sitting around the fire warming ourselves and drying our equipment. It was agreed that Pyramid Peak wouldn't be climbed the next day as planned, so the midnight celebrations were held on Central rather than Eastern time and everyone went to bed an hour later than usual. By that time the rain had turned to snow and we hoped that a good ski tour could be made the next day.

The next morning was still stormy, but some of the group decided to climb Mount Ralston anyway. At 9:30 a party of four, all experienced ski mountaineers, left the cabin. They were William W. Dunmire, Richard C. Houston, Allen P. Steck, and myself. The route to be followed was one that had been used many times previously under almost all snow and weather conditions. It crossed Upper Echo Lake to an orange ski trail marker at the Boy Scout camp at the upper end, went through a meadow,

then followed a prominent open ridge that starts just south of the stream draining Tamarack Lake and curves to the south to meet the main ridge forming the southwest wall of the valley. From the point at which this ridge intersects the valley wall, the route is a gradually climbing traverse up the lower slopes of the valley wall until the large cirque on the northern face of Mount Ralston is reached about 300 feet above Ralston Lake. The route does not cross any prominent avalanche chutes, but traverses two or three open slopes bare of trees for about 150 to 200 feet above it. It is almost entirely on north-facing slopes.

The day was stormy, with gusty high wind, and a moderately heavy fall of wet snow. Before the storm of three days earlier there had been three weeks of clear weather, with the result that there was now about 18 inches of wet snow over a base of very hard snow or ice. Large avalanches had occurred at Echo Lake in the past, and the party was not unaware of this danger. We had crossed one small patch of avalanche debris and had heard at least once the dull crunch of the snow settling under us. We were approaching a small rocky knob about 100 to 150 feet high that lifted above the route as we came to the cirque north of Ralston, and were discussing the possibility of a snow slide or avalanche on the open slope below. We all felt that the area was so small that even if the slope should slide we would be in no danger. It was here that the remark was made that "no one ever heard of a skier being buried in the Sierra."

We started across the slope on a climbing traverse, Allen Steck leading and followed by myself, Bill Dunmire, and Dick Houston in that order. As we anticipated no danger, we were skiing tip to heel. We used climbers and Arlberg straps—the thin strips of leather designed to keep the ski fastened to the boot in case the binding should come loose. Three of us had safety bindings. When Steck had reached a point about fifty yards beyond the trees where we had entered the open slope, a slide started from a break-off point about thirty feet above us and about 200 yards wide. My impressions of the avalanche are vivid. The slope was concave and varied from 15 degrees at the bottom to 60 degrees at the top; we were moving on a slope of about 20 degrees. There was a low thud, and cracks appeared on the whole slope at once. I shouted "here it goes" and felt myself side-slipping down the hill at not too fast a rate. I have no recollection of falling, or of seeing Steck in front of me, but I do remember thinking that this couldn't be happening to me. When the slide stopped I knew that I was buried, but I had my left hand and arm free enough to clear the snow from my nose and mouth. I must have unconsciously reached up to shield my face as I was buried. For a few seconds I could

move the upper part of my body enough to get breathing clearance for my chest, then the snow consolidated so that any movement except with the free hand was impossible. I had the idea that my left arm was above the surface and that I was throwing handfuls of snow out of the hole above my face. As I shook off my mitt to give my hand more freedom and uncovered my eyes, it became apparent that I was really in trouble. There was a solid ceiling of snow above my head and my free arm was only in an air pocket below the surface. I could see light through the snow but could not even reach the roof over me.

The snow held me as firmly as if it were cement—no longer the friendly substance which was a companion to my carefree hours. As I realized that there was no hope of extricating myself, I gave up all movement and called for help in the hope that at least one of us was still on the surface and uninjured. My answer was nothing but silence and a low moaning in front of me. At the time I thought it must be Bill Dunmire, but it was Al Steck who had been just ahead of me when the slide started. It seemed that he was badly hurt and that the others must also be buried. Our situation would therefore be desperate. I thought I was able to analyze my own situation pretty clearly. I was warmly dressed and in a comfortable position, lying on my right side with my head slightly higher than my feet. My feet were together and parallel. Since I could see light, it seemed that I would get enough air to be in no immediate danger of suffocation. If outside help did not arrive I felt sure that I could survive for at least twelve hours. However, my only chance for ultimate survival, I felt, was that another group from the cabin would follow our route and pass close enough to hear my calls. But would the falling snow blot out our tracks? Would they hear me if they did come?

"This is it," I thought, "a painless way to die but not quite the right time for it." I prayed to our Maker, and contemplated the dismal fact that I was probably going to freeze to death in a few hours. Problems that had seemed quite important a couple of days ago suddenly seemed very trivial. Yet it didn't seem possible that this was I who was buried here. These things happen to other people in far-away places, not to me and my friends. Every few seconds I would call for help with no effect. After what seemed like ten minutes, but was probably thirty, I either heard or felt movement on the surface. I called again and heard my old friend Morgan Harris, whom I had known since Boy Scout days, shout almost directly above my head, "Here's another one." He immediately dug through the roof of snow above my face with his hands, and moved on to search for the moaning as soon as he was assured that I was all right.

The whole party had indeed been buried. Al, who was closest to the center of the slide, was deepest. He was lying face downward with his head about three feet below the surface. His left leg was wrenched around behind his left shoulder in a strained position. He was unconscious or semiconscious, and was unable to breathe freely because of his position and the snow pressure against his chest. I was next to him and was next deepest. Bill Dunmire was completely buried, but could just reach the surface with one hand. He was in almost the same position as I was, even to having removed his left mitt. He was comfortable, and in addition had the advantage of being in contact with Dick Houston. Dick, who was last in the party, had his head above the surface and had managed to get one arm free. He and Bill almost immediately heard one another, but could not contact me or Al.

Dick had fallen almost as soon as the slide started and had had time to take a couple of swimming strokes in the approved manner before he stopped. He was buried least deeply, but whether this was due to the swimming motion or the fact that he was nearest the edge of the slide is debatable. The rest of us feel that there was nothing we could have done to help ourselves at the time the slide started. The snow was sliding all around us and took only five or six seconds to reach the bottom of the clearing. We think that we were still standing until about the time that we stopped and were then submerged and pushed ahead downhill by the snow as it piled up in a deep ridge at the bottom of the slope. All four of us ended up in the same relative position in which we were before the slide occurred, in a straight line across the slope, sixty to seventy feet below our original spot, and about fifteen feet above the trees at the end of the open area. Al was directly up the slope from a large red fir, and the position of this tree may have increased the turbulence of the snow around him, causing his leg to be twisted.

The slide that had imprisoned and rendered helpless our relatively strong party was by almost any standard a very small one, no larger than hundreds that come down during or after any heavy snowfall. Yet probably only the chance arrival of the second group prevented the death of at least one of us. This second group had left the cabin about thirty minutes after our group. It included John and Louise Linford, Morgan and Marjorie Harris, John and Jeanette Harper, and Edward Bennett. They had also intended to go to Ralston Bowl, and followed our tracks across Upper Echo. Already the old tracks were almost obliterated by wind and newly fallen snow. At the head of the lake they debated whether to try to follow the tracks any further or to make a new route.

John Linford proposed an alternate route to the north that went up the floor of the little valley instead of curving around the side of the mountain. However, Morgan Harris finally convinced the others that it was easier to follow the tracks wherever they could be found than to break a completely new set. They then put on climbers, and the Harrises and Linfords started ahead of the other three. They soon rediscovered our trail, which was still clearly visible in areas protected from the wind, and proceeded to follow it. The trail was again lost on the exposed ridge following, but Morgan was familiar with the route followed by the now buried party and found it again just below the slope that had avalanched. And so we were rescued.

As they came to the edge of the open slope, they heard Dick Houston's voice calling "Come, quick, there's been an avalanche." Not realizing that he and the rest of us were in trouble, their first thought was that we had only stopped for lunch. Then as they came close enough to see only Dick's head and shoulders protruding from the snow and the rest of us not at all, they hurriedly started searching. Dick was unhurt and directed them to Bill Dunmire, who was also located immediately and unhurt. As soon as Morgan was assured that Bill was all right he moved on and heard me. After clearing a space above my head, he and the others started to dig about ten feet in front of me but were directed back by the moaning much closer to me. One of Al's hands was soon uncovered, about 18 inches below the surface. It was out of the mitt and had turned a bluish color. His head was uncovered next; he was breathing with great difficulty, groaning, and only partly conscious. He had been unable to clear an air space around his head or to make space for the chest movement necessary for breathing. By the time the weight had been removed from his back so that he could breathe, his hand had gone limp and he had apparently stopped breathing, giving his rescuers the fear that he had expired.

As soon as it was determined that Al might be seriously injured, Louise Linford and Jeanette Harper were sent back to the cabin to get Dr. Howard Parker, another member of the house party, as well as to procure a toboggan and additional manpower. As soon as they arrived at the cabin two members of the party immediately started to Echo Chalet to see if a Weasel could be sent up the lake as far as possible. Other parties in the area were alerted and made ready to go to the site of the accident. Unfortunately Dr. Parker had taken a different route to Ralston Bowl with two others and could not be located. The toboggan was not where it was expected, and the Chalet's Weasel could not operate on the thin ice of the lake. The telephone lines were down, so an effort to get other oversnow

transportation failed. While these attempts were made, Louise and Jeanette started back to the scene with blankets and first-aid supplies.

Meanwhile, at the foot of the avalanche, Dick Houston had been freed and was helping to dig out the rest of us. I was extricated next, adding one more to the effective digging force, and soon Bill Dunmire was free. Al had regained consciousness, and while three of the party worked at his rescue the others made a platform of skis for him, and built a fire of "squaw wood." The snow had compacted nearly to ice around us as the slide settled, and digging had to be done with skis rather than hands. I had an aluminum ski-repair tip in my pack, which was a great help for digging. As all of us still had our skis on, a hole large enough to get at the front hitch on the bindings had to be dug before we could be moved.

When Al was finally freed after about forty-five minutes of digging, he was lifted from the cave which had been dug around him and placed on the ski platform. Three of his rescuers huddled around him to give what warmth they could until he could move. He recovered very quickly, and soon moved next to the fire. To the amazement of all, his only injury was a not-too-badly wrenched knee, and he soon felt that he could return to the cabin under his own power.

All of the skis had been recovered by this time. Al had lost both poles, and each of the rest of us had lost one. While Al was recovering, John Harper and I started back to the cabin to notify the various groups that a rescue party was not needed. The balance of the party started shortly thereafter and all were back in the cabin by 2:30 P.M.

While, fortunately, no one was killed or injured, everyone in the party was deeply impressed by the fact that there had been a near tragedy. The members of the party were all experienced mountaineers and skiers with a better than average knowledge of snow conditions and avalanche hazards. My three companions had spent six months of the previous year in the Himalaya, and I have been ski touring for twenty years. As it was not uncommon for such a party to return long after dark, no concern would have been felt for us until too late to start a search. The time lag in organizing and getting an effective, well-equipped rescue party to the scene was alarming. Even with the victims located, a minimum of two to three hours would have been required to get toboggans and blankets to the scene. If all four had been casualties the task of getting them to shelter would have been formidable indeed.

Every winter week end thousands of skiers are in Sierra slopes far more dangerous in appearance than the one that buried our party. As the skiing population grows, an ever-increasing number are drawn to the adventure

of touring, away from the packed slopes and the convenience of ski patrols and first-aid rooms. In the hope that one result of our accident may be the prevention of some future tragedy, we feel that the conclusions arrived at as a result of it should be set forth, even though some of them have been basic ski-touring technique for years.

1. A very small slide is far more dangerous than most of us have thought. Sierra avalanche hazards need further study. This should include snow conditions, terrain, and weather history. All the experienced ski mountaineers who looked at the slope after the slide agreed that they would not have hesitated to start across it.

2. Very conservative routes should be followed wherever possible.

3. A "strong party" is of no use to itself if all its members are caught at the same time. On terrain with even a remote possibility of avalanche, the party should maintain spacing such that it would be impossible for all to get caught in the same slide.

4. All cabins in use by skiers should have really adequate first-aid equipment immediately available. This should include toboggan or ski stretcher, splints, chemical hot pads, and complete first-aid kit. A thermos bottle can be helpful.

5. Every touring party, even on single-day or half-day tours, should be adequately equipped to handle a serious injury. A sleeping bag, ski-repair kit, first-aid kit, matches, and light are some of the essentials that all competent ski tourers know they should have in a party, but are often too lazy to carry.

6. On all ski tours a definite "flight plan" should be left at the point of departure. This should be definite enough to narrow the field of search to a limited area in the event of an accident. After starting the tour, this route should be followed as closely as possible. Every effort should be made to return before dark.

Notes and Correspondence

FRANK ALVAH KITTREDGE, 1883–1954

On December 10, 1954, Frank A. Kittredge died at his Palo Alto home. For 25 years Mr. Kittredge distinguished himself as an executive in the National Park Service. On the occasion of his retirement from government service on May 31, 1952, Oscar L. Chapman, Secretary of the Interior, stated: "Mr. Kittredge's professional activities have been characterized by technical knowledge of the highest type, enabling him to meet challenging engineering problems with both brilliance and practicality; with unimpeachable integrity; with a driving ability to work long hours far beyond those of the usual hard worker; and with an idealism and an enthusiasm for his work and for that of his bureau that are an outstanding example to others. Despite his unusual record as an engineer, Mr. Kittredge's value to the government has not been confined to the technical phases of his work. He has studied every phase of National Park Service activity, acquiring knowledge that has served him and the service well in administrative capacities as well as in engineering."

Frank Kittredge became Chief Engineer in the National Park Service in 1927 and continued in that position for ten years. Prior to this, he had devoted twenty-two years to highway engineering in the employ of the Alaska Central Railway (1905–1907), the Washington State Highway Commission (1907–1911), the Oregon State Highway Commission (1913–1915), and the Bureau of Public Roads (1917–1927). While with the Bureau of Public Roads, in 1924, he surveyed, designed and got ready for contract the Going-to-the-Sun Highway in Glacier National Park. Following this significant undertaking, came an assignment which resulted in the preparation by Kittredge of an all-inclusive program for the construction of wagon roads throughout the National Park System. It was a natural step from this special work to the establishment of an engineering division within the Park Service. In 1927 Kittredge became Chief Engineer for the new division and set up the San Francisco office from where came plans for the modernization of public utilities, roads, and trails in many parks and monuments.

In 1937, regionalization of the National Park Service was made permanent and Frank Kittredge became regional director for the Pacific Slope states, with headquarters in San Francisco. He was responsible for the broad supervision of all Park Service programs in such parks as Olympic, Mount Rainier, Crater Lake, Lassen Volcanic, Yosemite, and Sequoia-Kings Canyon. The staff of specialists with which Kittredge surrounded himself is well represented today among the executives and technicians still employed in the Region Four office, 180 New Montgomery, and in the Western Office of Design and Construction, 1000 Geary Street.

After four years as regional director, Kittredge became Superintendent of Grand Canyon National Park (1940–1941), and of Yosemite National Park (1941–1947). He became Chief Engineer once more in 1947 and continued in that work for five years, retiring at the age of sixty-nine.

From the University of Washington, Kittredge obtained a B.S. degree in 1912 and a degree in Civil Engineering in 1915. He married Catharine Mears in 1915, and to this union was born a daughter, Catharine Jane. During World War I, he served in France as a captain of engineers.

Frank Kittredge was descended from English and Scotch ancestors who came to America in colonial times. Among his forebears were farmers, teachers, preachers, and engineers, from whom he inherited a love of the outdoors. Throughout his professional career he allied himself with conservation societies and did effective work on problems pertaining to the preservation of the American scene. After his retirement from government service he was elected a director of the Sierra Club. CARL P. RUSSELL

THE NORTHERN OUTPOST OF GIANT SEQUOIA

THE PLACER COUNTY Big Tree Grove has two distinctions—it is the smallest and it is the most northerly of the natural groves of *Sequoia gigantea,* that largest of all trees, which occurs only in the Sierra Nevada of California. This grove is named the "North Grove," or "American River Grove" by Fry and White in *Big Trees* (Stanford Press, 1930). This northern outpost of giant sequoia, or Sierra redwood as it is also called, is about 60 miles north of the Calaveras Big Trees State Park. That distance represents one-fourth of the entire range of giant sequoia, which extends about 250 miles south to Deer Creek in Tulare County. No other gap between groves is as great as that between the Placer County and Calaveras Big Trees groves.

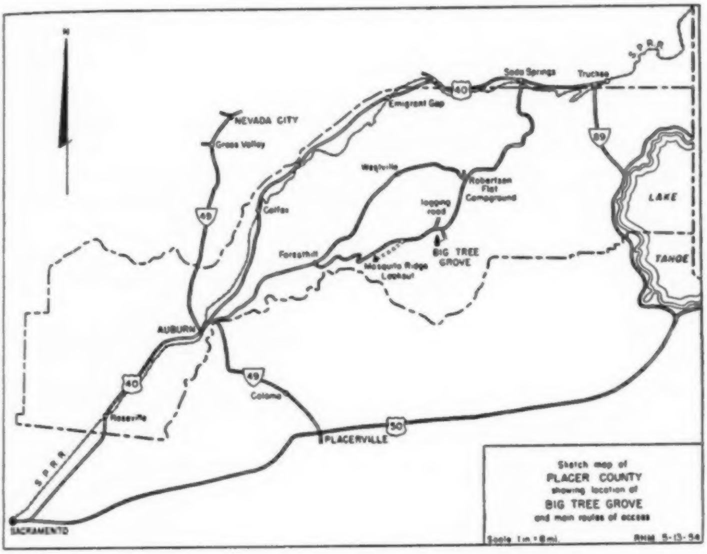
The Placer County Grove is about 40 miles northeast of Auburn by way of Foresthill, and about 25 miles due west of Lake Tahoe in the Foresthill Ranger District of the Tahoe National Forest. The U.S. Forest Service has withdrawn about 160 acres surrounding and including the grove as a public-service site, forever dedicated to public enjoyment.

This unique grove is said to have been discovered by a miner, Joe Matlock, in 1855. It was visited not long after by residents of the county and others, as evidenced by dates ranging from 1860 to 1890 carved in the smooth-barked alders along the little stream which runs through the grove. These were observed in 1891 by William W. Price, whose account of the Placer County Grove—the first authentic published description—appeared in the *Sierra Club Bulletin* for January, 1893.

The Placer County Grove includes 6 old, live, giant-sequoia trees and 2 dead sequoias said to have fallen in the nineteenth century. The two largest trees, named Pershing and Haig, are not large in comparison with such famed trees as the General Sherman in Sequoia National Park. The Pershing tree is about

10 feet in diameter (at 4½ feet above uphill ground level) and about 225 feet tall. The Haig tree is almost 9 feet in diameter, but about 250 feet tall, or the equivalent of a 25-story building.

The Pershing and Haig trees were named as part of a dedication ceremony in August, 1920, shortly after World War I—evidence of the popularity of



these two leading Allied generals. The ceremony took place under the auspices of the Auburn Chamber of Commerce and other Placer County groups, in coöperation with the U.S. Forest Service.

Of the four smaller trees, three are between 4 and 5 feet in diameter, and the smallest is a little over 2 feet in diameter (at 4½ feet above the ground).

The fallen trees have lost their bark and sapwood by fire and decay. It is difficult to measure their diameter accurately at a point equivalent to that measured on the now standing trees. When these dead giants were alive, the smaller may easily have had a diameter of 10 feet, and the other was considerably larger. The smaller of the two was measured as 154 feet in length to a burned-off top about 4 feet in diameter. The larger was estimated as 216 feet long, also to a 4-foot diameter. Forest fires more than 50 years ago undoubtedly burned the tops of these dead trees.

As there were no young trees in this grove, some giant-sequoia seedlings have been planted. The earliest planting was made in 1928 by the Native Sons of

the Golden West. About 10 small trees were planted in the draw which crosses the grove. Three of these have survived, but they are only 4 to 6 feet tall, being stunted by damage from bears.

The next planting was done by the Forest Service in 1949. About 50 small seedlings were planted over the entire grove area of about 5 acres. Only 3 or 4 seedlings survive. These plantings suffered from crowding by the underbrush, so in 1951 the Auburn Lions Club, in coöperation with the U.S. Forest Service, cleared some of the brush and planted about 35 potted seedlings 10 to 12 inches high, at least 30 of which were growing well by the summer of 1953.

The Placer County Grove is best reached from Auburn on Highway US 40, from which one should take the paved county road to Foresthill. The pavement ends about 15 miles from Foresthill, but a good dirt road continues about 4¾ miles. From this point a trail of about ¼ mile leads to the grove. The nearest improved campground is at Robertson Flat, 8 miles by fair road north from the Big Trees. However, motorists may picnic at the end of the road where the trail takes off to the grove. The area itself is preserved in a natural state.

RICHARD H. MAY[1] and GLEN E. SINDEL[2]

FREEZE-DRIED MEAT—A NEW TREAT FOR PACK TRIPS

HAMBURGER, fried chicken, pork chops, lamb chops, sirloin steak—how would these look on the menus of hungry pack trippers who are losing their taste for the monotonous assortment of canned meats that have been the mainstay of their diets in the mountains? All of these fresh meats were enjoyed by the Adam, Langlois, and Harper families on a pack trip into the Fourth Recess, last summer. In fact, the seventeen members of the party ate so well that fresh trout frequently went begging.

These meat items constituted what are probably the first field test of a new product—freeze-dried meat. Meat prepared by this process is first frozen, and the resulting ice is evaporated directly without allowing any thawing to take place. It is by such sublimation of ice that a snow level may drop without a thaw, or a wet wash will dry on the clothesline on a cold, windy day even though it remains frozen. Anyone who has kept meat in a freezer over a long period of time has probably observed a considerable drying of meat in poorly sealed packages. Such drying proceeds very slowly and is accompanied by other undesirable changes, so that the quality of the meat suffers. If the meat is kept under a high vacuum while it is being dried, the rate of drying can be greatly increased. For example, essentially all water can be removed from a steak one inch thick in about twenty-four hours.

Dried meat is nothing new, of course, and for thousands of years man has used drying as a means of preservation. Spoilage caused by bacterial action is

[1] Forester, California Forest and Range Experiment Station, Berkeley.
[2] District Forest Ranger, Tahoe National Forest, Foresthill.

prevented because bacterial growth is suspended in the absence of free moisture. The loss in weight that accompanies drying is of secondary importance, although it is of no small interest to the back packer. The usual dried meat, however, does not very closely resemble the fresh product. As with all proteins, considerable shrinkage takes place on drying. The water migrating to the surface as drying proceeds brings with it soluble constituents that are deposited near the surface. There is also some loss of water that is chemically combined with the protein. An impervious layer is formed at the surface which makes complete drying difficult, and rehydration of the shrunken meat to anything approaching fresh meat is not possible.

There would be considerable interest in a meat product that does not require refrigerated storage and that has the acceptability of fresh meat. The demand by mountaineers and sportsmen would be enthusiastic, though relatively small. The advantages of such a product for the armed forces are obvious, and it is here that the major demand would lie. In order to accelerate development of a suitable product, the Quartermaster Food and Container Institute for the Armed Forces is currently sponsoring a number of research projects. One such project has been active for the last two years at the University of California under the leadership of A. L. Tappel in the Food Technology Department at the Davis campus. More recently, the writer has been associated with this project. The efforts of the group working on it have been directed toward the development of the freeze-drying process to the point at which it can be used for the commercial production of meat. The meat brought on the mentioned pack trip was prepared in laboratory equipment used on the project.

Freeze-drying is not a new process. It is applicable to any material that can be frozen without damage and has been in use for preparation of biological and pharmaceutical products for many years. Large quantities of blood plasma, antibiotics, and vaccines are preserved in this manner. Its principal advantages over more conventional drying processes are that heat-sensitive materials are not subjected to the detrimental effects of high temperatures, volatile constituents are not lost, the physical form of the material is essentially unchanged, and rehydration is readily accomplished.

During the freeze-drying process, meat undergoes no observable shrinkage such as takes place in other drying processes. Inasmuch as the ice crystals cannot move about in the meat, water is free to migrate only as a vapor, and soluble constituents are not carried to the surface. The dried meat is rigid and has a porous, cellular structure. It somewhat resembles balsa wood, although the pores are larger and it is more easily compressed or broken. A faint odor of the original meat remains. Beef retains a light pink color; pork, lamb, and chickens are more grayish. The really important characteristic of the freeze-dried meat is its ability to rehydrate. When immersed in water, it will regain most of the lost weight in a short time. Steaks one inch thick would require one-half to one hour for rehydration. The best part of all, from the viewpoint

of the consumer, is that when cooked, the rehydrated meat is difficult to distinguish from fresh meat.

Storage tests have shown that freeze-dried meat, if properly packaged, can be kept at room temperature for as long as two years without suffering appreciable deterioration. All that is necessary is to package it so that oxygen is excluded. It can be vacuum packed in cans or packed in either cans or flexible, air-tight wrappers in an atmosphere of nitrogen or carbon dioxide. If the meat is stored in the presence of oxygen, it develops a brown or dark gray color and has a burnt or fishy taste when cooked. Exclusion of oxygen also prevents the development of rancidity in the fat present.

From the point of view of the back packer, the saving in weight is important. About 75 per cent of the weight of fresh, lean meat consists of water. Because of the presence of bone and fat and because not all water is removed in drying, the dried meat will weight from one-half to one-third as much as fresh meat.

It may be asked why freeze-dried meat is not available in the markets if it is such an outstanding product. The answer lies in the fact that, although the process is not new, it has not previously been applied to commercial production of relatively low-cost food items. Much information will have to be obtained regarding storage stability, packaging, conditions of processing, design of equipment, cost of production, consumer acceptance, and potential demand before we can expect to see freeze-dried meat on the market. As evidenced by the reaction of those who ate it on the pack trip last summer, a product can now be produced which would have immediate acceptance among mountaineers and sportsmen, who would not be storing it for more than a few weeks. These constitute a relatively limited market, however, and the requirements of the armed forces are much more exacting. Moreover, it is not known if freeze-dried meat can be produced commercially at a price the consumer would be willing to pay. The only processing equipment available is of a relatively small size designed for experimental work or for pharmaceutical manufacturers. Such equipment would not be the most efficient for large scale processing of meat, but equipment designed specifically for the job has not been built. One important factor affecting the cost of processing is the length of time required for drying. This time is controlled by the rate at which water vapor will diffuse through the meat to the surface. As mentioned above, a steak one inch thick can be dried in about twenty-four hours. A piece twice as thick would require about four times as long, so production of roasts seems to be out of the question for the present. Meat covered by skin, such as chicken, also requires a longer time. If the drying time could be shortened, it would mean that more meat could be processed in the same equipment and the cost of processing thereby reduced.

It is only a matter of time until freeze-dried meat will be available to all. How much time, it is difficult to say—perhaps two years, perhaps four. The cost is another uncertainty. One might hazard a guess that it will be about 50 per

cent greater than the cost of the equivalent amount of fresh meat. There is a great appeal to the idea of being able to enjoy fresh meat during one's entire stay in the mountains, no matter how far from the end of the road. For the time being, this privilege will be limited to those who have access to the appropriate laboratory equipment.

J. C. HARPER

YOSEMITE FIELD SCHOOL RESEARCH, THEN AND NOW

MANY YEARS ago a group of men interested in the Yosemite School of Field Natural History dreamed of a research area which would be set aside in Yosemite National Park for detailed ecological study. Colonel C. G. Thompson, then superintendent of Yosemite National Park, Dr. Harold Bryant, the late Joseph Grinnell and others, finally saw their dream materialize. In 1931, at the suggestion of Field School Director C. A. "Bert" Harwell and with the approval of the superintendent, an area was selected.

The area chosen, called Boundary Hill Research Reserve, consists of a twenty-five square mile section that lies in a roughly triangular shape north of that section of Yosemite Valley included between the fork of Cascade Creek and the Hetch Hetchy and Yosemite Trail. It is not too inaccessible from the valley, yet not so accessible as to tempt casual visitors. Assistant Park Naturalist Harry B. Robinson described the place and purpose of this work in "A Digest of the Boundary Hill Research Reserve Reports" (Yosemite Museum, September, 1948) as follows:

> Low, rounded hills and U-shaped valleys, typical of glaciated regions, are common in the reserve. As the country rock is quite resistant, post-glacial streams have done very little cutting in any of the canyons. Debris-filled basins are frequently found in the canyons, as the result of the damming up by morainal material of the later gravelly inwash of the streams.
>
> The elevation varies from 9,202 feet on the high ridge in the northern part of the area, to 6,000 feet on the southwest section. However, nearly all the Research Reserve lies between an elevation of 7,500 and 9,000 feet. The majority of the streams drop about 1,000 feet in six to eight miles.
>
> Streams in the northern part of the reserve which flow west, join the Tuolumne River; those in the southern part flowing to the west, join the Merced River. All the easterly streams are branches of Yosemite Creek, which joins the Merced River in Yosemite Valley.
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> The Research Reserve includes sparse vegetation on ridges up to 9,200 feet, good stands of timber in the ravines, and lush growth of grass and other annuals in the meadows. Vegetation on the ridges consists, for the most part, of annuals growing close to the ground and a spotting of trees, chiefly lodgepole pine, white pine and red fir; and some hemlock and white fir. Lichens cling to walls of granite. The forest consists predominantly of red fir and lodgepole pine, with a scattering of Jeffrey pine; there is much young and vigorous growth in this forest.
>
> The region is largely in the Canadian Life Zone, but includes some of the Hudsonian, which begins at 9,000 feet. On the north side of the ridges the Hudsonian

creeps down to about 8,000 feet; on the southern side the Canadian Zone creeps up to a little above 9,000 feet.

During 1933–1937, Yosemite Field School classes spent a week or more making biological and geological studies in this area. Nine separate 100x100-square foot quadrats were established, each subdivided into 10-foot squares, for intensive work. Three of these quadrats were worked in 1933, two in 1934, two in 1935, one in 1936, and one in 1937. Later prewar classes laid out some plots in the Swamp Lake area to the west and a short distance outside the park.

The nature of the work has been a biological and geological inventory of the reserve—a "developing" biotic community. Emphasis has been placed on plant succession under a variety of environmental conditions. Although the study is primarily one of plant succession, it is recognized that a changing habitat with change of ecological associations means also a change in mammal, bird, and insect life.

The original studies were but the beginnings of a long-time program. They constituted a basis for future investigations, and the value of the work depended on future studies. No definite conclusions could be drawn until further investigations were made. It was hoped that the information derived from continued research might guide future policy and lead to better interpretation in the national parks.

No time interval was proposed, and original plans may have called for an earlier restudy; but it was always understood that the quadrats should be worked again not later than the twentieth year. As no work on the Research Reserve was being done by postwar Field School classes, it was obvious, as 1953 approached, that unless the alumni took action, nothing would be done and the good work already accomplished would be forgotten.

A canvass of available alumni met with a surprisingly favorable response, especially from the much-needed members of the 1933 Field School class. Eight alumni, some with their families, and three persons not from the Field School, attended the Research Reserve camp at Yosemite Creek campground on the Tioga Road, and helped with the work in 1953. Enthusiasm carried over into the 1954 season, when some of the same group and a few new volunteers assembled to rework the 1934 plots in early July.

A major incentive for this endeavor to carry out the original plans was the memory of Joe Dixon, beloved assistant director of the prewar Field School, who directed most of the work on the Research Reserve. Mr. Dixon retired from the National Park Service in 1946, and died in 1952. For the group of alumni to have a small part in carrying out his plans was, aside from any small scientific schievement, a great satisfaction.

The 1933-1953 reports are fairly complete, but most of the 1934-54 work has still to be written up. Two of the 1933 quadrats are more or less rocky ridge top, with changes over the 20-year interval, both geological and botanical, perceptible but not striking. The third quadrat, designed to measure encroachment of

lodgepole-pine forest on a mountain meadow, showed vast changes. Total trees had increased from 44 to 1634, with most of the original trees still standing and greatly increased in size.

One of the 1934 quadrats, laid out in a cirque at an elevation of 9,000 feet, showed no striking changes in 1954. Photographs from fixed locations were taken for comparison with 1934 pictures. One qualified alumnus wrote a detailed account of mammalian life. The other quadrat, a meadow location, included a shallow pond which was restudied in detail by aquatic biologists.

Restudy of these research quadrats is of unquestionable value. The alumni believe, however, that while they should have a part in the work, major responsibility should rest elsewhere. It is hoped that some kind of permanent committee can be formed to perpetuate these ecological studies indefinitely. Talent aside from the Field School, discontinued after 1953, is needed. There will be no new alumni, and the old ones are growing older.

ROBERT PAUL ALLEN

DONALD G. SHERLOCK, 1931–1954

Editor, Sierra Club Bulletin

Sir:

On July 21, 1954, Donald G. Sherlock, in the course of geological field work, attempted to ford Rapid River in the Seven Devils Mountains of western Idaho. The stream, swollen by fast-melting snow, swept him off his feet, and he was killed instantly when his head was dashed against a rock. Don was alone and on foot, and it was the day before his twenty-third birthday. Not until several days later was his body found at rest in a broad pool—the only pool in 30 miles of well-named Rapid River.

Don was born in San Francisco, the elder son of Wallace and Georgina Sherlock, and attended Oakland schools, including Fremont High School.

In 1949, Don entered the University of California at Berkeley. He joined the Sierra Club, and began a major in geology as a path to a profession in which he could combine science and mountaineering. He spent many winter week ends skiing at the Sierra Club near Donner Summit; he also went on a number of rock-climbing excursions.

Don belonged to several University choral groups, and was a participant in the University of California Men's Glee Club Tour to Mexico in 1950. He was active also in youth and choir groups of the Episcopal Church.

Don spent the summer of 1952 barnstorming Alaska with Jim Watson in a car almost as old as themselves. Don and Jim took jobs briefly to bolster the expedition's finances. While working for a gold-dredging company in the Tanana valley, Don found a mastodon tusk; later, the tusk became the showpiece of his California room.

In 1953, Don graduated from the University with a fine scholastic record, and used the summer to do geologic field work for a master's thesis, studying the granites of the Vermillion Valley-Mono Pass region of the Sierra. This work was done on a series of long solo backpacking trips, and included the climbing of many peaks of

that area. He met the Sierra Club High Trippers in the Mono Recesses, and lectured informally to them about the geology of the Sierra Nevada. Don returned to school, half-decided to head for a Ph.D. He was joined at the University by his brother, Bill.

During short vacation periods Don traveled to many mines in central California and developed a fast-growing collection of ore minerals. For a few weeks early in 1954, he worked in a mine near Redding as geologist and ore pusher. In June he started a summer job as geologist with the U.S. Geological Survey, and went to the Seven Devils where he was killed a scant three weeks later. He was engaged to be married at the end of the field season.

Don was an irrepressible and lovable chap with a dynamic zest for all new experiences and particularly for mountaineering, and his twenty-three years were crowded with activity. His death is a vast personal loss to many people, as well as a loss in potential achievement to the geologic profession and the fraternity of outdoorsmen.

Contributions from his many friends have established a scholarship in geology at the University of California in Berkeley.

WARREN HAMILTON AND PETER FREEMAN

Mountaineering Notes

Edited by Hervey Voge, Ruth D. Mendenhall and Elly Hinreiner

COAST RANGE OF BRITISH COLUMBIA, 1954

A party of seven, including two Sierra Club members, spent six weeks in the Coast Range during the summer of 1954. They were Bob Brooke, Gary Driggs, Nick Clinch, Jack Maling, Dave Sowles, and Gil Roberts, all of Stanford, and Andy Kauffman of Washington, D.C. Kenmore Air Harbor of Seattle flew the group in to Dumbbell Lake on June 25, and dropped supplies a few days later on the Upper Tellot Glacier, where a base camp was established.

Weather proved quite inhospitable, with a total of 28 days of storm, including one of ten days' duration. However, an igloo which could hold the entire group for eating and bull sessions did a great deal to make things bearable. Much to everyone's amazement, the igloo survived for an entire month.

A total of about thirty ascents were made. Climbs from the Upper Tellot included the first ascent of the Fourth Peak of Mount Serra, highest unclimbed peak in provincial Canada, by Kauffman and Sowles. This 18-hour traverse from the Serra II-III col also included an ascent of the Third Peak en route. Two other parties, Kauffman and Clinch, and Brooke and Roberts also climbed Serra III. Serra II was climbed by Driggs, Maling, and Clinch; and Serra I by Brooke, Roberts, Maling. Kauffman, and Clinch. All these peaks provided good climbs with quantities of ice and snow; occasional pitons were necessary. The Fifth Peak of Serra seems still quite inaccessible.

A traverse of Claw Peak, and Harvard, Cal, and Stanford Claws was made by Driggs and Sowles in a long day of high-quality rock climbing. Various members climbed Mounts Shand, Dragonback, Dentiform, Hearthstone, McCormick, and Argiewicz, and made first ascents of Tellot Spire, one of the Four Guardsmen, and several unclimbed pinnacles in the area.

The entire party packed down the Radiant Glacier and made a second ascent of Mount Tiedemann, second-highest peak in the range. The 6,000-foot snow climb via the Radiant Glacier was a new route. It offered some difficulty with the icefall, route-finding, and crevasses, which might make it impractical in a year with less snow, but it was an enjoyable climb. Seven people shared the task of step kicking.

Brooke, Driggs, Maling, and Roberts packed down to the Tiedemann Glacier late in the trip for an attempt on the east site of Mount Waddington, climbed by a Sierra Club party in 1950. The four reached Bravo Col, but because of extremely bad snow conditions and lack of time were forced to retreat when a fresh storm moved in. This same party was able to squeeze in an ascent of Mount Munday, made at night because of deep snow, from their Tiedemann Camp before returning to the Upper Tellot.

The party flew out of Dumbbell Lake on August 3, convinced of two things: First, the Coast Range, despite its weather, is truly a wonderful climbing area; it provides high-quality rock climbing combined with ice and snow climbing, and camping in a setting which can be called close to Himalayan in splendor. Second, the airplane is truly a boon to mountaineers. There is no more wonderful sound than the roar of

that engine breaking through the clouds to foretell the arrival of a six weeks' supply of food.

GILBERT JAY ROBERTS, JR.

MIDDLE CATHEDRAL ROCK

IN ADDITION to a great number of ascents of the standard routes in Yosemite Valley in 1954, there were several repetitions of not-so-standard climbs, such as the Lost Arrow; also several new projects were undertaken. Chief target among the new objectives was Middle Cathedral Rock. In 1953 the northwest buttress of this fine rock fell to the party of Bill and Marj Dunmire, Jack Davis, Dick Long, Dick Houston and Dale Webster. Later in the year Jack, Bill, Dick Long and Bob Swift investigated a possible route traversing the massive north face from Gunsight Notch. Climbing was strong, the party was not, and the matter was not pressed. Then, over the Memorial Day week end of 1954, Frank Tarver and Warren Harding teamed up with John Whitmer and Craig Holden to complete a spectacular route up the north buttress of the rock. This route had been surveyed often and attempted several times in years previous. Three days were consumed in the final assault, and a considerable amount of difficult climbing was necessary.

Following through on the reconnaissance of the prior season, Dick Long, Jack Davis, George Mandatory and Bob Skinner completed the traverse of the north face of Middle Cathedral Rock on the fourth and fifth of July, 1954. To round things out, Warren Harding, John Whitmer and Bob Swift started a route up the east buttress of the same rock. Many pitons and bolts were used in attaining the high point, and many more will be needed in finishing the climb.

ROBERT L. SWIFT

NICKEL PINNACLE

THE FIRST ascent of this sixth-class pinnacle was made on November 21, 1954, by Mark Powell and George Whitmore. Nickel is the prominent pinnacle on an arête of the lower east face of Middle Cathedral Rock in Yosemite Valley. From Cathedral Chimney two fourth-class pitches led the climbers to the main notch, from which they traversed north to the Penny-Nickel Notch. Then, using a two-man stand to get started, they forced a route up a direct-aid piton crack on the west side, finishing the route fifth class on the north face. Penny and Nickel have fallen. On to the Half-Dollar; no quarter will be given!

GEORGE SESSIONS

SPIREVIEW POINT

IN EARLY April of 1954 George Sessions and Dick Irvin climbed for the first time the most easterly point of the mass behind the Cathedral Spires. Separated from the main mass by a 250-foot deep notch, the square cut summit (elevation 6,250) lies directly and considerably above Phantom Pinnacle. The approach was made up the talus chute just east of the spires, passing the Phantom and turning west up a side gully some distance above. Following north along the crest of the main mass, a short scrambling descent to the east led to the col west of Spireview. The climb itself began with a hundred-foot pitch up holds of a quality seldom encountered in Yosemite Valley. A short scramble above led to another even shorter pitch which offered a rather objectionably strenuous overhang. Good solid fifth. The summit block

offered a flaw on the east side, and the flaw offered a route. The route offered a hold. They rejected the hold and offered a piton. The piton was accepted and they arrived at the top. The summit offered no cairn building material, but a generous vista of the spires, complete with a daring human fly on the flake alternate. In the absence of even a piton crack on the top the summit block was climbed down, with three short rappels completing the descent to the col. The climbers felt that the length and difficulty of the ascent were somewhat less than is usually found in Yosemite Valley if this be evaluated by a length-of-climb to talus ratio. In fact, the length of the approach is no doubt to be thought of as disgustingly opprobrious in these days of degeneration. Friendly little summit though.

RICHARD K. IRVIN

KINGS CANYON CLIMBS

A GROUP of climbers from Fresno has been exploring the rock climbing possibilities of Kings Canyon, which appear to be vast. Some of the more interesting climbs completed, from Boyden's Cave back up the river, are as follows:

Kings Tower appears as a fantastic one-hundred-foot spire from Highway 180 in Kings Canyon west of Redwood Creek. It was first ascended May 16, 1954, by Wayne Kincheloe, Richard Sessions, George Sessions, Larry Hawley, and Chris Jessen. The approach was made up a gully west of the tower to the south notch. The route lies on the nearly vertical south face. It is maximum class 5, for although the climb has been led entirely fifth-class, most parties use one or two direct-aid pitons.

The south arête of Windy Cliff was first ascended in July, 1954, by George Sessions and Merle Alley. It was class 5. The east arête of Boyden Rock, likewise class 5, was first ascended in June, 1954, by Mark Powell, George Sessions, and Merle Alley.

GEORGE SESSIONS

SKI TOURING ON THE COLUMBIA ICEFIELD

ON JULY 23, 1954, Mark Meier and I decided to take a partial day off from glaciological work on the Saskatchewan Glacier; and a brief ski tour on the Columbia Icefield beckoned as a fine busman's holiday. We considered nine o'clock as a good skiers' starting hour and after a short hike up the medial moraine reached the firn line and put on the skis. At the divide between the Saskatchewan drainage and the Castleguard Glacier, we were within view of Mount Bryce, Columbia, Castleguard, and even Sir Stanford. Here we performed our work for the day, digging a ten-foot hole in the snow and taking samples every six inches for laboratory analysis. By four o'clock the job was done and we again pushed our skis along, this time up the western slopes of Mount Castleguard. Rounding the north ridge we proceeded diagonally up the east face and crossed the snow-filled bergschrund into a small bowl only a hundred feet from the top. Leaving the skis, we scrambled up some wet ledges and fifty feet of talus to reach the top at 6 P.M. A cold wind and the late hour gave only a few minutes for photography and enjoyment of the view. The whole Columbia Icefield stretched out to the west and north of the summit, and to the south rose seldom-climbed Mount Bryce with its sheer north face and triple summit. The sun was now low, and with the eastern slopes in shadow we found breakable crust. Jelly-fish nerves changed the first few parallel christies into kick turns. The rest of the run down was on good spring snow. After a descent of 1,200 feet, we reached the

almost level slope of the shoulder and schussed for over a mile to the point at which the shoulder drops off to Castleguard Pass. On this slope the angle is about twenty or twenty-five degrees, and the loss of altitude over a thousand feet. This provided the best skiing of the day even though it was after seven in the evening. The last skiing was through the morainal debris to the pass at 7,500 feet. Here we cached the skis and walked down to the Alpine Club hut after a most worthwhile day.

George Wallerstein

BELLA COOLA—1954

Two hundred miles north of Vancouver the Bella Coola River rushes to the ocean from coastal highlands. Shortly before reaching its goal, the river is supplemented by the contributions of Noomst, Kahootin and Snootly creeks, which join it from the south. These tributaries have their origin in a group of glacier-clad rock peaks of a sort which mountaineers find hard to resist.

On Wednesday, August 4, Bob Skinner, Dick Long, Jim Wilson, and I bade farewell to sunlight and civilization and stepped into the brush of Kahootin Creek. Two years before, Bob, and Dick and Bill Long had found slow going on Noomst Creek (to the east). Therefore we had decided to ascend Kahootin Creek and reach our area by way of the Noomst-Kahootin Col. For a new man (one who had supposed that "Devil's Club" was some sort of social organization) there were innumerable delightful discoveries, but by Saturday we had made a good three miles and were again free of the greenery. Through the murk, fleeting glimpses of unclimbed, unnamed peaks led us over our pass to the headwaters of the Noomst.

After a quick ascent of Monster Mountain we established camp on Saturday and ducked into our shelter under the stimulus of a slow, steady rain. Despite a quick sally to the summit of Happy Meadow Dome we were distinctly restive by Wednesday and braved the weather in a reconnaissance to the south. Shortly after noon, while standing ankle-deep in a powder-snow avalanche, we voted for adjournment to our camp. While descending the Mad Dog Glacier I turned a knee and was forced to remain quiet for the next several days. Thursday brought the first promising weather; and making good use of it, Bob, Jim, and Dick climbed and named Mount Kopas, a fine 10,000-foot wedge of snow and rock. On the following day, August 13, they ascended Mad Dog Mountain, but the ascent of Phantom Spire was delayed by excessive static effects. Next day the Phantom Spire fell to fifth-class climbing; and to round out their day the three put up a route on Space Point Spire, one of the first peaks to attract our attention when we approached the area. Had there been a single primary objective for our expedition, it would have been the Horn. This fine peak (Don Munday's Blanche Tip) had been sulking in the clouds east of camp since our arrival. Now, with two days of climbing left, Bob and Dick crossed the head of Noomst Creek and completed an ascent by the south ridge. They were forced to bivouac, however, and returned the next day, while Jim and I climbed the south tower of Orbit Peak.

It was time to leave. After recrossing the Noomst-Kahootin pass, we traversed the headwaters of Kahootin Creek through a succession of lush, misty meadows to the Kahootin-Snootly pass. Fortunately a logging road was close by and on the following day we enjoyed the hospitality of friends in Bella Coola.

Robert L. Swift

RECENT CLIMBS IN THE HIGH SIERRA

Matterhorn Peak.—An ascent of the north ridge of Matterhorn Peak on the Sawtooth Ridge was made by Jerry Gallwas, Wally Kodis, and Don Wilson on September 1, 1954. From the glacier they ascended east of the truncated lower third of the steep sharp arête, arriving in three pitches at a platform above the truncation. After one pitch along the arête itself, they traversed onto the west face and followed a steep crack 100 feet up to the large ledge below the final 200 feet of arête. Traversing left they ascended a chimney with a large chockstone, then followed a subsidiary ridge on the east face, 50 feet from the arête. At its end, three possible one-pitch routes lead to the summit. The climb involved about four hours of roped climbing on eight pitches, some of moderate fifth-class difficulty. Many variations are possible.

Palisade Crest.—On July 4, 1954, John and Ruth Mendenhall ascended the three easternmost pinnacles of the Palisade Crest from a snow camp just below the most easterly of the small glaciers feeding the South Fork of Big Pine Creek. The first pinnacle was climbed by a couloir east of the crest, followed by one fifth-class and several fourth-class pitches.

The Grand Dike.—Tower No. "½" of the Grand Dike (Kings Canyon area, southeast of Monarch Divide) is a minor pinnacle below Tower No. 1. It was reached for the first time on November 26, 1954, by Kim Malville, John Ohrenschall, and Richard Smyth. Crossing the tops of the chockstones wedged between the walls of Tower No. 1 and the pinnacle, they reached the northeast corner of the pinnacle and traversed a ledge on the northwest face to a short chimney. To this point it was third-class climbing. They ascended the chimney, working their way to the right of a chockstone (fifth-class), and reached the summit block by a short fourth-class pitch.

Balloon Dome (6,881n; located near the junction of the middle and south forks of the San Joaquin River).—Climbed September 7, 1954, by John Ohrenschall, Mark Powell, and Ed Searby who found a large cairn, but no record. Class 3 from the saddle south of the dome.

Peak 13,046n (east of Charybdis on the Black Divide).—Climbed August 13, 1954, by Frank Orme and Robin McKeown who rated it second-class, with third-class near the summit. They found a cairn, but no record.

Peak 12,920n (southeast of Charybdis).—Also climbed by Orme and McKeown on August 14, 1954. They found no evidence of a cairn. Second-class from the west.

Ragged Spur (between Goddard Creek and the Enchanted Gorge).—On August 17, 1954, Frank Orme and Robin McKeown climbed Peak 12,855n on the Ragged Spur, finding no cairn or record of previous ascent. First-class from the west. It was climbed again on August 31 by Paul J. Sullivan who also noted cairns on Peak 12,841n (by binoculars) and two other high points along the ridge.

Mount Reinstein (12,604n; southwest of Mt. Goddard).—A cairn, but no record was found by Frank Orme and Robin McKeown when they climbed it on August 18, 1954.

Mount Hutchings (10,785n; north of Zumwalt Meadows in Kings River Canyon). —Climbed in the summer of 1954 by Karl Hufbauer and party who found record of an ascent by Norman Clyde and a companion (name illegible) on April 1, 1933.

Kearsarge Pinnacle No. 6.—Climbed by Dwight Ericsson of St. Paul, Minnesota, on August 18, 1954, by an easy third-class route from the 5–6 notch. He found what appeared to be a disintegrated cairn, but no record.

Reviews

Edited by Dan L. Thrapp

The Sierra Club and Mountaineering are, to many of us, practically synonymous terms, and books on mountains and good climbing bulk large in the chapter libraries. Here are reviewed some of the best titles received from publishers during the past year.

A CLIMBER'S GUIDE TO THE HIGH SIERRA. Edited by Hervey Voge. Sierra Club, San Francisco, 1954. 312 pages, 18 photographs, 28 sketches. $3.

[In lieu of a book review we asked Hervey Voge to explain a bit about how the *Guide* came to be written—something of its history and the people who were involved. This he has done, but characteristically he has said very little about his own part in it. Many people contributed to the book, of course, over a long span of years —twenty at least. But what got the book out was the combined diligence and talent of Hervey Voge and the corps of people he enlisted to do the necessary rewriting of what had been written and to write the part that we had been trying to get written for nineteen of those twenty years. We enlarged on this theme in the monthly *SCB* —on what was back of the *Climber's Guide,* and Hervey's part in the completion of this prodigious task—but we feel we must again call to our members' attention this outstanding example of work freely volunteered for the good of the club. D.R.B.]

Publication of the *Climber's Guide* in 1954 represented a landmark for Sierra Club mountaineers. For years the guide had been talked about; for years various authors labored on manuscripts covering different areas, but the task was so great that completion seemed always to be in the distant future. In the end, however, it was found that every effort had contributed, and when all the loose pieces were tied together a very impressive volume resulted. A little history regarding this volume will interest all who use it.

Twenty-two years ago, in 1933, the Committee on Mountain Records started collecting information on ascents in the High Sierra, and the idea of ultimately publishing a guidebook soon arose. A firm basis for this project was established when Richard M. Leonard, in 1937, listed the peaks of the High Sierra and the known ascents, up to the first five. The number of peaks was so great that a piecemeal approach was indicated, and it was decided to publish chapters of the projected guide in the *Sierra Club Bulletin*. The first chapter, "The Sawtooth Ridge," by Leonard, appeared in 1937. Additional chapters were written in each subsequent year through 1942, but then the war intervened.

A tragic automobile accident in 1946 indirectly speeded completion of the guide. William Shand, Jr., a well-known Sierra Club climber, was killed in that accident. Because of his great love for the mountains, his parents wished to establish a mountain memorial. Although a hut was suggested initially, there was no site immediately available, and publication of the *Shand Memorial Guide* was chosen as a worthy project. David R. Brower, then chairman of the editorial board, reprinted the six

existing chapters of the guide in a paper-bound preliminary edition in 1949. He also issued a call for help in revising these chapters and in writing the eleven remaining chapters. Response to this call was generous, but many difficulties beset early completion. However, the persistence of Brower and his chief coörganizers, Gene Hammel, Allen P. Steck, and the undersigned, finally brought completion.

The *Climber's Guide* was throughout a coöperative venture. Twenty-three authors participated, and at least fifty others contributed in one way or another. The information in the guide has come from diverse sources, including second ascenders whose names are not mentioned. The guide has attempted to describe all significant peaks from the northern edge of Yosemite National Park to Army Pass south of Mount Whitney, as well as rock climbs of Yosemite Valley and Kings Canyon. Many knapsack routes are also included, along with information as to approaches and campsites. So the volume forms a complement to Starr's *Guide to the John Muir Trail*, which primarily describes the trails.

Much enjoyment of nature's ways should accrue to those who explore the High Sierra wilderness with or without such guide books. In this use of the mountain area climbers will be essentially conservationists—of their own lives through safe practices (we hope)—and of the peaks, which they do not seek to alter. As stated in the guide, it is not likely that climbers, with their little cairns, their footprints on the sandy shelves, or their evanescent tracks upon the sparkling snowfields will cause significant changes in the landscape. HERVEY VOGE

THE MOUNTAIN WORLD 1954. The Swiss Foundation for Alpine Research. Edited by Marcel Kurz. Harper, New York, 1954. 224 pages, 64 illustrations, 12 maps, sketches. $6.

The second annual volume in this series, edited and printed in Switzerland, keeps to the high standard established last year in providing a review of the major mountaineering expeditions of the previous year.

In recording mountaineering activity for 1953, *The Mountain World 1954* has two outstanding successes to relate—the ascents of Everest (29,002 feet) and Nanga Parbat (26,660 feet). The Everest section is illustrated with a remarkable series of eight air photos taken by the Indian Air Force a week after the ascent by Hillary and Tenzing. Sir John Hunt expands the theme that success was the culmination of the work, thought, and hopes of many hundreds of people in all walks of life. Wilfrid Noyce has a long article in his readable personal style giving his account of the expedition.

The ascent of Nanga Parbat is related in two articles by G. O. Dyhrenfurth and Karl M. Herrligkoffer, much in the manner of the latter's book-length account.

The Swiss expedition to Dhaulagiri (26,810 feet) climbed to within 2,100 feet of the summit and confirmed the opinion that it is one of the most difficult 8,000-meter peaks. The little publicized Japanese expeditions of 1952 and 1953 to Manaslu (26,658 feet) show that the relative inexperience of the Japanese is tempered by determination and ability.

Charles S. Houston, with a report on K2 (28,250 feet), contributes the only article by an American. In a section entitled "Medical Aspects," he attributes the ability of the 1953 expedition to operate at a high altitude for so long to the heavy packing done by the climbers themselves above base camp.

Many smaller expeditions have visited the Himalayas in recent years and Marcel

Kurz does a fine job of summarizing those of 1951–1952. A chart lists all known expeditions in the Himalayas 1940–1952 with references to printed accounts. Mention should also be made of the articles on mountaineering in Africa and the Arctic which includes "The Seismic Examination of Glaciers" by Hans Röthlisberger.

Even though several expeditions reported in this volume have been described in published books, no instance of mere copying was evident. Each report has been freshly written and manages to tell the story in a different manner. The photographs are outstanding but the lack of margins is disturbing. In studying the plates one must search deep into the fold of the book to see the entire picture. This is especially serious where the photographs appear opposite each other, and it is often difficult to tell whether one is looking at a double-page spread or two single plates.

The continued publication of these annual volumes will contribute a great deal to one of its announced purposes, removing national rivalry and the recognition of the prowess of climbers of other nations.

MUIR DAWSON

ALONE TO EVEREST. By Earl Denman. Coward-McCann, New York, 1954. 255 pages, 13 photographs, 4 maps. $3.75.

One who has read accounts of the various major expeditions to Mount Everest will enjoy the novelty of following Earl Denman to 23,500 feet with two Sherpas, no porters, and two donkey-loads of baggage, crossing the border into Tibet without permission, all of it financed on a shoe string by Earl Denman himself.

Mountaineers may find much to criticize in the author's techniques, and in his attitude toward authority; his unorthodox approach to both is what sets his account apart from other published records of climbing on the world's highest mountain.

The first half of the book is taken up with his conditioning for Everest—climbing the eight Virunga volcanoes in central Africa. Some will lay the book down before they reach the more interesting parts, as it makes a slow start.

Denman's attempt on Everest took place in 1947, six years before the mountain was finally conquered by the British. One of his Sherpas was Tenzing, for whom this was the fourth attempt, and Denman gives some interesting sidelights on this now world-famous climber. "Everest belongs first of all to the Sherpas," says the author.

His approach to the mountain was intensely idealistic, "not in the spirit of a conqueror but rather as a lover." When the mountain finally fell to the British he "rebelled inwardly at the thought of Everest being subjected to army methods of assault." In the end he tempered his bitterness with the thought that "when the conquerors have come down from the mountains then we shall be able to go to them again simply and quietly."

He is sure that Everest can and will be climbed without oxygen; he thinks he might have made it with six or eight more men.

His realistic account of the miseries encountered on the march, and of the scenery (which he did not find beautiful), his failure to adorn or dramatize these accounts, all add to the impression that this is a very personal story by a very original thinker.

LOUISE TOP WERNER

A TREASURY OF MOUNTAINEERING STORIES. Edited by Daniel Talbot. G. P. Putnam's Sons, New York. 1954. 337 pages. $5.

Refreshing is the word for this anthology of short mountain stories. With nineteen authors from five occidental countries writing over a period of 150 years on mountains

all over the world, we enjoy widely varying treatments of the subject. For Guy de Maupassant the Swiss Alps are merely a background for a plainsman to weave one of his favorite tragedies. But Ralph Bates leaves a rock climber breathless with an authentic episode in the Pyrenees during the Spanish Civil War.

In an age that has provided a succession of factual accounts of actual mountaineering experiences, this collection composed almost exclusively of fiction comes as a welcome change of pace. As a painter can improve on a photographer in portraying a mountain scene, so can a fiction writer surpass a chronicler of mountaineering history. Talbot, himself only an armchair mountaineer, has chosen only the best of story tellers. They do not dwell on atmosphere or description, but on swift moving plots, characterization, psychological insight, and drama. With writers like Kay Boyle and James Ullman, and with climbers like Mummery and Frison-Roche, how could this be other than a treasury of mountaineering stories? BOB BEAR

IN THE JOURNALS

Alpine Journal, May, 1954. London. *American Alpine Journal,* 1954. New York. *Climbers' Club Journal,* 1954. London. *Scottish Mountaineering Club Journal,* 1954. Edinburgh. *Canadian Alpine Journal,* 1954. Banff. *Appalachia,* June, 1954. Boston. *Mazama,* December. 1953. Portland.

With the recent increase of activity in that greatest of all mountain ranges, most of the 1954 mountaineering journals are naturally dominated by Himalayan-expedition articles, and eight different Himalayan expeditions are described in one or more journals. Secondary emphasis is upon mountaineering at home (wherever that particular journal is published), and for this reason the American journals will have more general appeal to our readers. The *Sierra Club Bulletin* seems to be unique in its scope of general mountain interest; most other journals are strictly concerned with mountain routes and ascents rather than with natural history, conservation, or other aspects.

The feature articles of the *Alpine Journal* continue an Everest series begun in the November, 1953, journal. Here "The Last Lap" is described by Hillary similarly to his chapter in Colonel Hunt's book. Oxygen apparatus is discussed in much greater detail than in the book, however, and this modern analysis should be essential reading for those who are interested in the technicalities of oxygen use in mountaineering. André Roch (translated into English) tells of the Swiss attempt and failure on the formidable north face of Dhaulagiri that was climaxed by a several-hundred-meter fall on steep snow by three Sherpas who were miraculously unscathed. Roch's conclusion is that new techniques such as dynamiting camp sites, which "in fifty years' time will be accepted as commonplace by all mountaineers," will be necessary for the eventual ascent of this *Achttausender.* Two light reconnaissance-type expeditions, one to the seldom-visited Pir Panjal Range in the Punjab and another to the Yalung Valley just south of Kangchenjunga, complete the Himalayan accounts. Other articles on the Alps, Salcantay (in French), and Ruwenzori are of more limited interest.

The 1953 American attempt on K2, as described by co-leader Robert Bates, heads an exceptionally fine issue of the *American Alpine Journal.* This, as will be remembered, was the struggle where the members were forced by storm to spend ten days above 25,000 feet without oxygen, an achievement that had previously been declared impossible by physiologists; tragically one man was lost. There is also an account

of an expedition making the first ascent of Mount Cook and an attempt on Mount Logan in the St. Elias Range, Alaska; it was only slightly delayed when Sierra Club member Richard Long was stricken with appendicitis on the glacier and had to be flown out of the area. Described are also climbing, exploration, and mapping (maps included in the journal) in the Northern Purcells by Harvard and Dartmouth parties and in the Canadian Coast Range north of Mount Monarch by American Alpine Club members. Notable is an account of Fred Ayers' climbing and measuring the Natural Bridge in Zion National Park; the span of the bridge proves to be the longest yet recorded at close to 300 feet. Certainly to its credit, the *American Alpine Journal* does not restrict itself to purely American exploits. It presents a beautifully illustrated report of a Japanese attempt on Manaslu (26,658 feet), and an account of the ascent of Nun Kun (23,410 feet) by a French party including a woman (the highest female ascent yet). In general, the *A.A.J.* appears to be the best edited of the journals reviewed, and it certainly excels in selection of photographs.

In the *Climbers' Club Journal* first impressions of the South Col of Everest are given by Wilfrid Noyce whose conclusion seems to be that "it is a desolate spot." Apparently even Britons will occasionally stoop to "piton stripping" on a climb. In a humorous vein the ascent of a difficult ridge on the Grandes Jorasses (Alps) is recounted; the route description in the guide book revolves around a certain piton, the Piton Croux, placed eighteen years earlier, during the first ascent. And after the present ascent, "We were sorting out pitons, and there in the pile was an unfamiliar rusty one; we turned questioningly to him who had come last, taking the pitons out. His look confirmed our horrified thoughts: he had taken out the Piton Croux!" This journal is mostly concerned with mountaineering in the Alps or the Isles, but there is an account of a trip to Monument Valley, Utah, taken in mid-winter. There is also a note on direct-aid climbing, a technique which now seems to be quite accepted by the younger British mountaineers.

Most space of the *Scottish Mountaineering Club Journal* is given to short accounts of new climbs in Scotland. The classification terminology used is fascinating with such designations as "very difficult," "mild-severe," "hard-severe" (when done in rubbers!), and "extremely severe"; one climb was listed as "moderate." A light Scottish expedition climbed a 22,000-footer and several lesser Himalaya peaks in Nepal west of Mount Everest. We cannot help but envy those who live so much closer to the greatest of ranges and who are able to make small successful expeditions in part of a summer with only one year's planning, much as our climbers travel to Alaska or Peru.

The *Canadian Alpine Journal* is certainly justified in concentrating on mountaineering in Canada. The principal contributions this year deal with the Coast Range. The climbing of Mount Good Hope and the mapping of this little-known area are described; also the numerous ascents by a party in the Waddington area to the north, so familiar to many of our own climbers; and an expedition further north, on Mount Monarch, also covered in the *American Alpine Journal.* There is an account of the Harvard Mountaineering Club leadership school holding a session in the North Selkirks, and reports of the accomplishment of twelve first ascents (mostly new routes). Mount Robson was the scene of considerable activity in 1953—unclimbed, although often attempted, for fourteen years. Three separate ascents are described, including one by members of the California Himalayan Expedition. N. E. Odell makes some reflections on Mount Everest and lends support to those who feel that oxygen is not

always necessary and may even be a hindrance for Himalayan expeditions. It is noteworthy that the Alpine Club of Canada holds a regular mid-winter ski camp. This year's camp was held at Berg Lake beneath Mount Robson, and featured two ascents of Mount Resplendent.

Appalachia will undoubtedly hold more interest for the nonclimber than most of the other journals. This issue is well provided with historical sketches, restricted to our eastern mountains, however. Besides several poems there is a good mountain fiction piece with a truly interesting twist. Bradford Washburn outlines another of his proposed routes in Alaska, this one on the South Buttress of Mount McKinley. Pointing out possible routes is one thing, but describing a yet untried climb, slope by slope, campsite by campsite, and hold by hold almost in the manner of a climbers' guide seems quite another. (All from air photos.) In my opinion these essays, although intended to stimulate mountain pioneering, actually tend to discourage it. Many mountaineers will welcome a climbers' guide to the North Selkirk Range by William Putnam that appears in this issue.

Although the articles are shorter, in content *Mazama* resembles our *Sierra Club Bulletin* perhaps more than any of the other climbing journals. The annual club outing to the Mount Shuksan area is featured along with articles on Oregon climbs, river touring, and mountain menus. Conservation is well represented here. The Olympic National Park boundary dispute is discussed and Olaus Murie presents a fine paper defining "wilderness." It is disappointing that not more mountaineering organizations take a strong preservation stand.

The Club library also receives several other mountaineering journals including the *New Zealand Alpine Journal*, the *Journal of the Mountain Club of South Africa*, *Harvard Mountaineering*; the first two publications are nearly entirely limited to local activities, while most of Harvard's enterprises are covered in the other journals.

WILLIAM W. DUNMIRE

The wilderness, in any of its myriad forms, is what the Sierra Club is all about. Here are summarized some of the most interesting books concerned with this subject, received during 1954.

THE WILDERNESS WORLD OF JOHN MUIR. Edited by Edwin Way Teale. Houghton, Mifflin, Boston. 332 pages, illustrated. $4.50.

Of the great American naturalists of the nineteenth century, John Muir is actually the least known to our generation. His books are not easily obtained, and most of them are out of print. The cult of John Muir has been largely confined to the Far West, where devotees have kept his name alive in such organizations as the Sierra Club and in connection with natural places like Muir Woods or Muir Glacier in Alaska. Few anthologists of American prose seem to be acquainted with the bulk of Muir's works, and the ideas he propagated have naturally more appeal to Westerners than Easterners.

We must therefore hail with enthusiasm *The Wilderness World of John Muir*, ably edited by the sensitive naturalist Edwin Way Teale, a selection of writings arranged (with pertinent editorial notes) in such a way as to present in sequence the running story of Muir's life. While an anthology cannot give the reader the full scope and magnificence of Muir's books, it whets the appetite. Many who will dip into it will

not be content to stop there. They will wish to read *The Story of My Boyhood and Youth, A Thousand-Mile Walk to the Gulf, My First Summer in the Sierra, Travels in Alaska, Our National Parks,* and the *Journals.*

What kind of a man was John Muir and what does he have to say to us? Teale's short introduction is an admirable *précis* of his life and character. Of Scotch ancestry, Muir was transplanted as a boy to a wilderness farm in Wisconsin. He had no formal schooling after leaving Scotland, but managed to spend four years at the University of Wisconsin without, however, taking a degree. Quite early he showed his love for naturalistic observation—the outdoors was his schoolroom, and nature his teacher.

Oddly enough, Muir had a practical bent and made a reputation as an inventor both at the university and later. His ingenious clocks and other contraptions made him famous in Madison, and as manager of a wagon-wheel factory in Indianapolis he was well on the way to a fortune. But an accident to his eye turned him forever away from machines. When his sight was sufficiently restored he set out on a thousand-mile walk to the Gulf of Mexico, and never stopped wandering for the rest of his life. In middle age Muir married and partly settled down, managed a ranch at Martinez, and was said to have cleared $100,000 in ten years.

Unlike such naturalists as Thoreau, Muir traveled far and wide across North America and eventually to other continents. He was not merely the observer, recording in poetic form impressions of winds and storms, mountains, glaciers, and forests, but an analytical scientist whose greatest contribution was to point out the role glaciers played in forming the Sierra, particularly the Yosemite Valley.

Teale's anthology ranges the gamut of Muir's writings. It contains reminiscences of his youth, exultation in his Sierran wanderings, descriptions of Far Western forests, and the record of explorations among glaciers and Indian villages in Alaska. Muir's style is revealed in all its subtlety and power—the exact observations of birds and game animals, mountains and plains, and the hymns to nature; description of strange people met on his ramblings; conversations with sheepherders, hermits, prospectors, Indians; and, above all, the conservationist's plea for restraint in slaughtering wildlife and mutilating natural features of the landscape.

ANTHONY NETBOY

THE MATING INSTINCT. By Lorus J. Milne and Margery J. Milne. Little, Brown, Boston, 1954. 243 pages, illustrated. $4.50.

This book, illustrated with twenty-one line drawings by Olaus J. Murie, considers the world's most fascinating topic from the natural scientist's viewpoint. Its authors have studied and photographed animals and plants while motor-camping more than 200,000 miles through North and Central America. In *The Mating Instinct* they investigate the activities that constitute the various and amazing animal-mating behavior, and recount the story of life in nontechnical language, with many delightful touches of humor. They tell how potential mates recognize each other, whether fireflies, fish, silk-worm moths, lizards, frogs, robins, deer, or grasshoppers.

Variety in mating habits seems to be practically endless. Techniques of pursuit are described, and reasons for combat between mating rivals are explained, from the majestic bighorn sheep to the formidable Hercules beetle. Courtship may consist of colorful and intricate ceremonies, or may not exist at all. For perpetuating the miracle of life animals have developed a remarkable array of specialized devices. Finally the young emerge into the world, some as eggs, some as active living creatures ready at

birth for an independent existence or, like baby opossums, more like living embryos facing weeks of complete dependence. Parental care is instinctive, with each animal doing just the right things for survival of its kind. In many creatures we find that the sexes are more alike than they are dissimilar. But the unlikenesses have intrigued mankind from time immemorial. As the French hail it: "Vive la différence!"

JOAN D. CLARK

FIELD GUIDE TO ANIMAL TRACKS. By Olaus J. Murie. Houghton, Mifflin, Boston, 1954. 374 pages, illustrated. $3.75.

This is a most complete work. Its 1,000 sketches depict the tracks of virtually all the mammals of North and many of Central America, plus those of a number of birds, reptiles, including snakes, amphibians, insects—and even lightning. Not content with that, Murie, who surely ranks high on the nation's honor roll of naturalists, slips in uncounted assists for those to whom "reading sign" is the most fascinating of all detective work. For instance, he provides identifying drawings of gnawed twigs and limbs, bird pellets and castings, horn and bone chewings, and other natural phenomena. His comments, which run throughout the book, are a fulfillment of the expectations of those of us who think of Dr. Murie as America's finest nature writer since Ernest Thompson Seton.

In many instances, where tracks are likely to be smudged, Murie includes a sketch of the paw or hoof for your benefit in the field, and his delightful animal sketches are sprinkled liberally through the book. There is space for one's "life list" of tracks observed, and a very complete list it is. The writer even describes how to make casts of tracks for later study or other use.

Of greatest help to the beginner is a five-page key at the start. Somebody coming across a strange track may thus, at a glance, know where to look in the main part of the book.

Most of the material shown was collected in the field. In a few instances, notably the jaguar record, they were secured at a zoo; others were obtained by live-trapping the animal and then gathering its fingerprints.

Not only will this guide book add hugely to your understanding and appreciation of the back country's wild creatures, but it will provide more than one enjoyable armchair evening as well. It is a thorough delight, from Murie's foreword to the very end, where one finds three familiar imprints, drawn above a quotation from Thoreau: "If I were to make a study of the tracks of animals and represent them by plates, I should conclude with the tracks of man."

D. L.T.

An intelligent understanding of our western country depends upon a sound knowledge of its history. This subject each year is made more fascinating by the publication of significant new titles. The one reviewed below is of unusual interest to club members.

BEYOND THE HUNDREDTH MERIDIAN. John Wesley Powell and the Second Opening of the West. By Wallace Stegner, with an introduction by Bernard DeVoto. Houghton Mifflin, Boston, 1954. 438 pages, illustrated, $6.

Sierra Club members are greatly concerned these days about the problems that arise from conflicting claims upon the waters of the upper basin of the Colorado River

system, the region in which Major Powell made his earliest explorations. And today, as in Powell's time, the greatest difficulty is to bring about an understanding of the facts in order to dispel illusions and the misconceptions that arise from ignorance and misrepresentation. Wallace Stegner has helped to promote such an understanding through his bold and lucid account of John Wesley Powell's long struggle to make known the significance of the lands west of the hundredth meridian, namely, from the high plains east of the Rockies, across the Continental Divide, to the western rim of the Great Basin.

Stegner's book is a great deal more than a biography of the explorer of the Grand Canyon and the founder of the Geological Survey; it is more even than what he modestly calls a "history not of a personality but of a career." It is, rather, the history of an achievement, the extraordinary achievement of reversing a nation's concept of its territory. As a prelude, the author takes us through Powell's early explorations in the Rocky Mountains (the first ascent of Long's Peak), of the tributaries of the Green River (White River and Yampa River), and Brown's Hole (with glimpses of our now familiar Dinosaur country). Then comes the great "canyon voyage" down the Green River and the Colorado (the first boats through the Grand Canyon). The account of these expeditions and the commentaries thereon are by far the most discerning that have yet appeared. This section alone would make the book noteworthy.

But for Stegner, as for Powell, the experiences of this period are but preparation for the more important contributions to come. The true character of the arid lands, with their high plateaus and their deep canyons, had begun to unfold. Powell was now ready for the work that lay before him, the effort to change the attitude of promoters and law makers. They had seen this region either as a vast extension of the eastern farm lands (squared into sections and quarter sections), or as an uninhabitable desert. Powell, on the other hand, recognized all the "variety caused by altitude, latitude, topography, climate, soil, that characterized the West in contrast to the essential unity of the Middle West and East." He had also seen what the law makers in Congress had not seen, the redemptive qualities of irrigation as practiced by Indians and Mormons. He knew, too, the difference between irrigable lands and range lands for other purposes.

The latter part of this remarkable book deals with the ensuing struggle, in the midst of politics and bureaucracy, to give effect to these concepts. In the course of two decades land laws were reformed and changed back again, the Geological Survey was founded, mapping of the West was begun on a vast scale, the Irrigation Survey was created, and a new attitude toward Indians evolved through the Bureau of Ethnology. There were victories, and there were discouraging setbacks. Stegner has made all this into a fascinating story. It is the more exciting because it is not yet finished. For although Major Powell has long since departed, his ideas persist. There is much work still to be done to bring about a program of sound action based upon knowledge and understanding.

FRANCIS P. FARQUHAR

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